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# FUNCTIONAL RESTORATION OF THE FOOD PASSAGES IN EXTENSIVE STENOSING CAUSTIC BURNS OF THE PHARYNX AND ESOPHAGUS.*†

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## INTRODUCTION.

Stenosing esophageal strictures due to caustic ingestion have been treated by two methods: a conservative approach utilizing early intermittent endoscopic dilatations to prevent or dilate strictures has been advocated by some[1,2]; early surgical excision or substitution of the esophagus in established strictures has been proposed by others.[3-11] Regardless of the method of treatment for these lesions, the degree of function retained, once stricture is firmly established, is dependent upon their extent, location, and inflammatory activity.

The irreversibility of stricture formation was stressed by Bosher, Burford and Ackerman[12] in experimentally induced burns of the dog's esophagus. Holinger, *et al.*,[2] stated that early dilatations may prevent significant stricture formation,

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and that intermittent esophageal dilatations may then allow normal deglutition.

Within the past decade, the increased use of steroids for esophageal burns has perhaps minimized stricture formation.[13,15] From unpublished data[14] it appears that some patients with proven caustic burns of the esophagus may not develop significant strictures when treated only by steroids and antibiotics. Five of 40 cases so treated, with severe burns of the esophagus and/or pharynx, developed progressive stricture formation despite endoscopic dilatations.

We would agree that localized esophageal strictures necessitating infrequent dilatations by the endoscopic route should be treated by conservative means. We feel, however, that well established strictures which require frequent dilatations are better managed by surgical procedures which restore deglutitory adequacy.[11] There are, however, a number of cases where the burn and subsequent stricture involves the pharynx, epiglottis, and cricopharyngeal pinchcock as well as the entire esophagus. Heretofore these individuals have, of necessity, been committed to a lifetime of gastrostomy or jejunostomy feedings.

Observations made on 65 cancer patients in whom larynx sparing operations were performed, revealed that certain structures may be sacrificed without compromising function. These structures are the epiglottis, aryepiglottic folds, false cords, the greater part of the hypopharynx and one arytenoid cartilage. In addition, the superior laryngeal nerves, part of the cricopharyngeal pinchcock and the base of the tongue may be sacrificed.

These facts established by numerous publications on the conservation operation[16-19] suggested that the principles of this operation combined with a modified right colon transplant would re-establish normal deglutition in patients with extensive stenosis of the pharynx and esophagus.

Traditionally the otolaryngologist and thoracic surgeon have been interested in problems of the cricopharyngeal pinchcock. In the presentation of this subject, we stress

that a combined team approach is necessary to overcome this serious pathologic state.

Although this subject was presented in part before the American Association for Thoracic Surgery, the role of the otolaryngologist is of such importance in this joint service effort, that we felt that a presentation here seems necessary.

## HISTORICAL REVIEW OF ESOPHAGEAL SUBSTITUTION.

Substitution of the stomach, jejunum and colon for the esophagus has been done for many years. The first successful antethoracic jejunal replacement was performed by Roux of Lausanne in 1907. Jejunum is stated to be better physiologically than stomach as a substitute, because the vagus nerves are not cut.

Substitution of cervical skin[20] with a jejunal anastomosis as a two-stage operation has objections in that production of granulations and stricture formation at the junctional union is a common sequel. The jejunal segment alone lacks length when replacement of the entire esophagus is necessary.

Kelling[3] and Hacker[4] were the first to describe the use of the colon for esophageal replacement. Since 1911 there have been numerous publications[3-12] suggesting colon replacement for a variety of esophageal lesions. There have been no reported series of cases in the literature where colon substitution combined with reconstruction of the pharynx has been successfully accomplished for extensive caustic burns.

## TECHNIQUE.

At the time of anesthesia induction, the presence of marked pharyngeal scarring has presented difficult technical problems in endotracheal intubation. We feel that tracheostomy should be avoided during the first stage procedure.

In this series of patients, the operation has been staged to minimize possible contamination of the anterior mediastinum. Infection may occur as a complication of tracheostomy—a necessary technical step for laryngeal and pharyn-

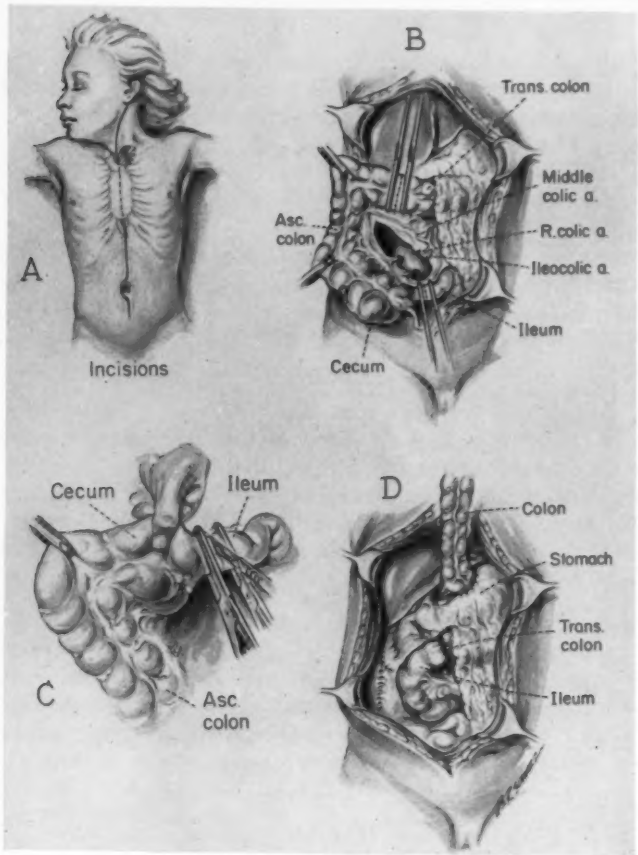


Fig. 1. Preparation of colon segment. A. Incision—A continuous skin incision is made from the angle of the jaw to just below the umbilicus. The shaded area shows bony structures of the sternum and clavicle to be removed. This provides space for the colon. B. Mobilization of the right and transverse colon. Note the inclusion of the middle colic artery in the vascular pedicle. C. Separation of cecum from ileum. D. Colo-gastrostomy to anterior surface of stomach. Note the end-to-end ileo transverse colostomy.

geal reconstruction. As our experience increases, we feel that a one stage procedure may be readily performed.

FIRST STAGE.

*Preparation of the Colon Segment.*

Simultaneously, while the anastomotic site of the hypopharynx is exposed by a second operating team, the abdomen is opened through a midline incision extending from the xiphoid process to below the umbilicus. (See Fig. 1-A.) The usual technique of right and transverse colon mobilization is executed. For the usual colon by-pass to the pharynx, we have been able to include in the vascular pedicle only the middle colic artery. (See Fig. 1-B.) Following ligation and division of the arterial branches, the colon segment is handled cautiously, since the avoidance of small subserosal and submucosal hematomas is mandatory. The colon segment together with its vascular pedicle is then passed posteriorly to the stomach and through an incision in the gastrohepatic omentum. (See Fig. 1-C,D.)

A median sternotomy is performed to allow precise placement of the colon segment within the confines of the anterior mediastinum. The transverse colon is divided at its proper site and subsequently an end to end ileotransverse colostomy is performed, while the cecum is being anastomosed to the hypopharynx by the other operative team.

A colo-gastrostomy is then performed on the anterior surface of the stomach. Although one strives to place the anastomosis high on the fundus of the stomach, extreme angulation of the distal colon segment must be avoided.

*Preparation of the Anastomotic Site of the Hypopharynx.*

Selection of the side of the pharynx for anastomosis is determined by direct laryngoscopy, and the pyriform sinus with the least scarring is used. The skin incision is made along the anterior border of the sternocleidomastoid muscle from the angle of the jaw to the suprasternal notch. (See Fig. 2-E.) The skin flaps and subcutaneous tissues are elevated over the larynx and dissection is carried toward the

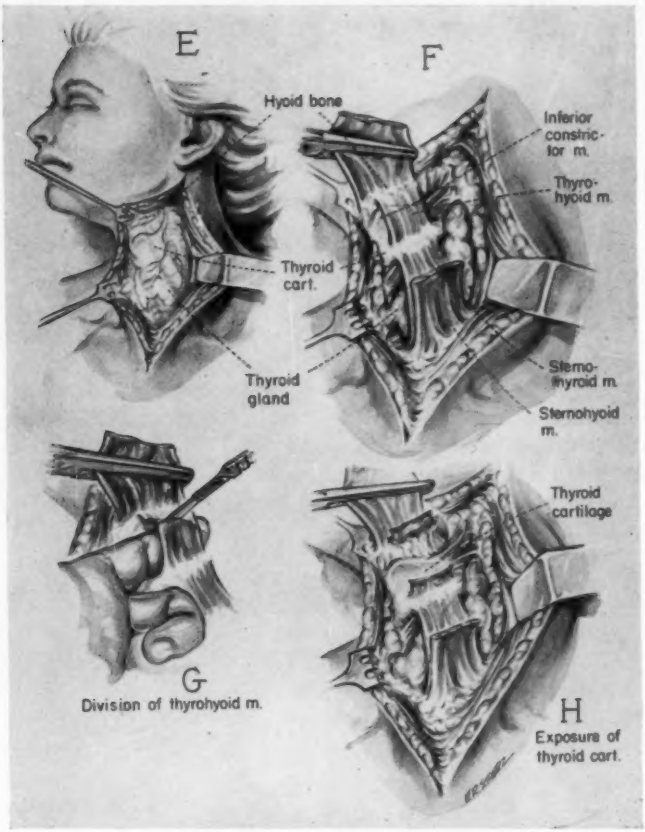


Fig. 2. Preparation of anastomotic site of the hypopharynx. Exposure of thyroid cartilage by transverse division of sternohyoid and thyrohyoid muscles.

postero-lateral border of the thyroid cartilage. The sternohyoid and thyrohyoid muscles are divided transversely at the superior border of the thyroid cartilage (see Fig. 2-F,G,H) and the medial constrictor muscles are divided along the postero-lateral border of the thyroid cartilage. From the thyroid notch to the superior cornu, the perichondrium is

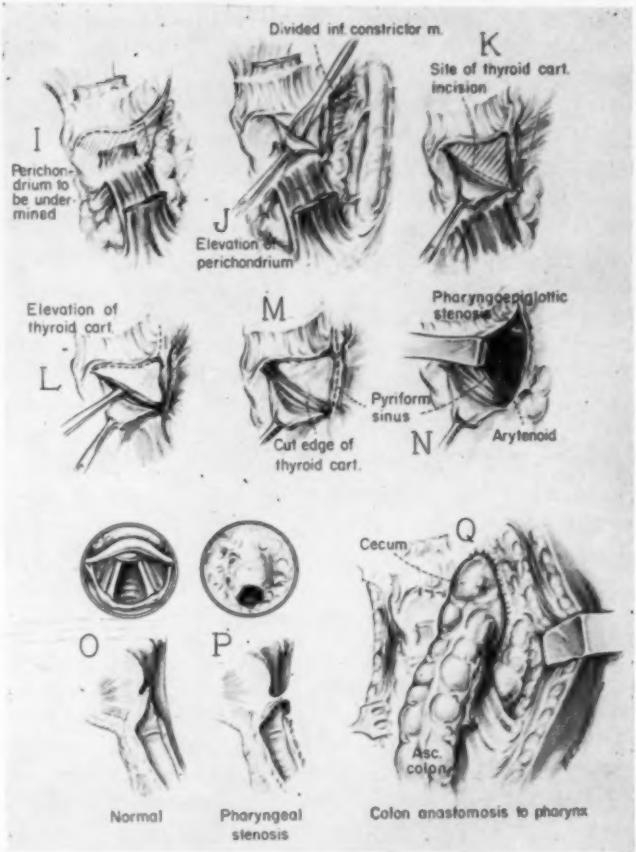


Fig. 3. Preparation of anastomotic site of hypopharynx. I. Dotted line indicates incision line of external perichondrium. J.K.L. Elevation of perichondrium and removal of thyroid cartilage. M.N. Pyriform sinus opened. O.P. Appearance of hypopharyngeal stricture. Q. End-to-side pharyngo-cecal anastomosis.

incised, and the external perichondrium is elevated inferiorly. (See Fig. 3-I,J.) The cartilage is incised obliquely from the thyroid notch to a point just superior to the inferior cornu. (See Fig. 3-K,L.) Resection of this cartilage will expose the internal perichondrium and the hypopharyngeal area. (See Fig. 3-M.)

The pyriform sinus will be seen bulging at the posterolateral border of the thyroid cartilage. When the cecum is presented for anastomosis, the hypopharynx is opened vertically, and one arytenoid eminence is identified. (See Fig. 3-N.) The incision is then extended superiorly to the point where the epiglottis and pharynx are bound laterally and posteriorly; this will create a substantial pharyngostoma. (See Fig. 3-N,O,P.) The cecum is now opened along a tenia for a distance of three centimeters and an end-side anastomosis is made with the hypopharynx, using a single layer of interrupted 0000 arterial silk. (See Fig. 3-Q, Fig. 4.)

Drains are placed into the neck and upper mediastinum, and the subcutaneous tissues and skin are then closed with interrupted silk.

## SECOND STAGE.

Two weeks after the colon substitution has been performed, the patient is prepared for the second phase. A preliminary paramedian tracheotomy is performed through the second and third tracheal rings under local anesthesia, and endotracheal anesthesia is then administered. Such a paramedian tracheostomy will lessen accidental exposure of the colon segment in the opposite side of the neck.

A wide transverse incision is carried across the hyoid bone and dissection of the skin flaps is carried for a short distance inferiorly to the region of the superior border of the thyroid cartilage. The hyoid bone is split in the midline with partial separation of the suprahyoid muscles. (See Fig. 5-A,B.) As dissection is carried into the pharynx, the mucous membrane of the vallecula will be identified.

Immediately upon entering the pharynx, the diaphragm-

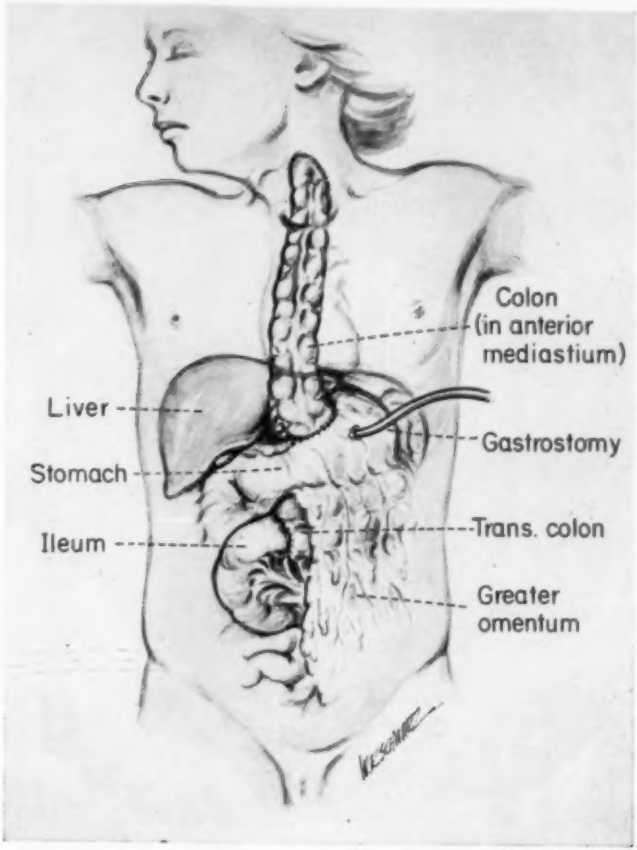


Fig. 4. Re-establishment of digestive tract continuity at the end of the first stage.

like epiglottic-pharyngeal scar will be identified. (See Fig. 5-C.) For additional exposure a midline extension is made inferiorly down to the thyroid notch.

The scarred supralaryngeal structures are excised. The epiglottis will be attached posteriorly by a dense broad band of scar tissue. The margins of the epiglottis are cut on each

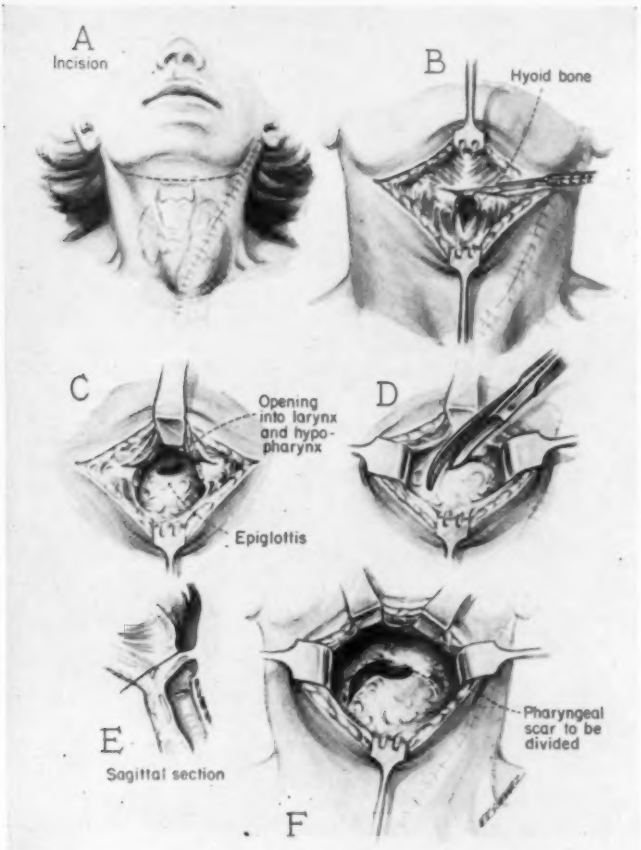


Fig. 5. Repair of pharyngeal stricture. Exposure of hypopharynx and separation of lateral epiglottis from hypopharynx.

side, but great care is exercised since normal landmarks are absent. (See Fig. 5-D.) The region of both arytenoids is next visualized, and one must avoid accidental incision into the colon, as the lateral glossoepiglottic structure is released from the pharyngeal wall. (See Fig. 5-E,F, Fig. 6-G,H,I.) The arytenoid cartilage should not be exposed, otherwise

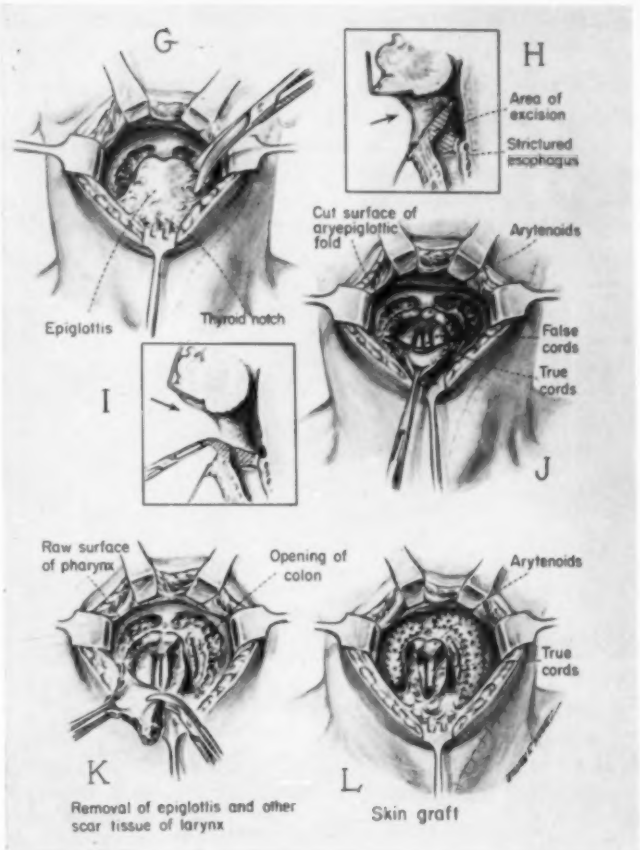


Fig. 6. Repair of hypopharyngeal stricture. Removal of supraglottic structures from hypopharynx and skin graft.

fixation of the cord will result. Impairment of one arytenoid will result in a hoarse voice, but bilateral fixation will present a serious problem with tracheostomy decannulation.

The scarred aryepiglottic fold is cut above the arytenoid cartilage and the dissection is carried into the endolarynx to below the level of the false cords. (See Fig. 6-J,K.) As one dissects with a curved scissors into the anterior pyriform sinus, the close proximity of the cut margin of the hypopharyngeal mucosa to the colon lumen will be evident. Great

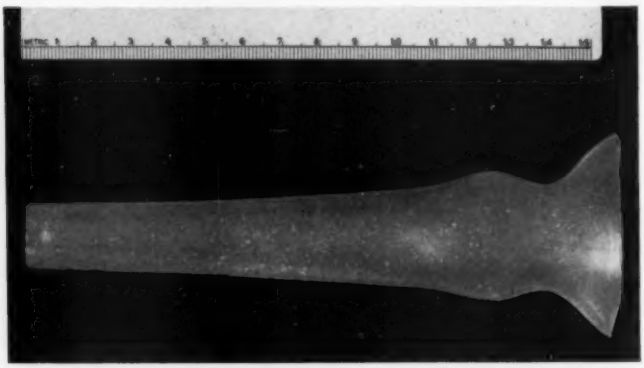

Fig. 7. Negus stent.

care is exercised to preserve a cuff of mucosa at the previous pharyngo-cecal anastomosis.

The entire epiglottis is then removed from beneath the thyroid notch together with the opposite false cord and aryepiglottic fold. At this point, one should lighten the depth of anesthesia to determine the function of both true cords. It will now be observed that both pyriform sinuses and the greater part of the hypopharynx will be devoid of mucosa.

A split thickness skin graft from the inner aspect of the thigh is taken and placed into the pharynx where it is held with catgut mattress sutures. (See Fig. 6-L.) The skin graft

is approximated closely to the small strip of mucosa along its posterior pharyngeal wall, and to the mucosal strip about the colon stoma.

If webs of the colon stoma are noted they are divided and an appropriate sized Negus stent is placed into the colon. (See Fig. 7.) This stent which assists in securing the skin graft to the pharynx should be anchored to the nose by a silk suture to prevent its accidental descent into the colon. The hyoid bone is sutured together, and subcutaneous tissues and skin are approximated with interrupted silk sutures.

## RESTITUTION OF DEGLUTITION.

Besides the routine postoperative care and feeding per gastrostomy, considerable attention must be given to tracheostomy care. The indwelling Negus stent is maintained for two or three weeks. Upon removing the stent, indirect laryngoscopy is performed. If the edema has sufficiently subsided, the patient may attempt deglutition.

The pharynx must be healed and the airway re-established through the larynx before deglutition is attempted. Difficulty with deglutition may last from several days to three weeks. Aspiration of liquids is the general rule with the first attempts at ingestion. The patient must make a conscious effort to clear the airway simultaneously with the effort to move food into the colon. Semisolid foods are the first to be tolerated. The tracheotomy tube must be corked at this point to use the expiratory air column to assist in clearing the larynx. During the rehabilitation period when liquids appear to be swallowed with some difficulty but solids reasonably well, the tracheostomy tube is removed. Rapid restitution to normal unconscious deglutition will be dramatic.

## PRESENTATION OF CASES.

Six cases with extensive stenosis of the pharynx and esophagus were operated upon. Of the six cases, five were completely successful. The only postoperative death occurred in a two-year-old boy. Five patients had ingested lye and one sulphuric acid. All showed extensive cicatricial stenosis of the

pharynx with almost complete closure of the esophagus necessitating gastrostomy for feeding purposes. None could swallow liquids or saliva, and aspiration of pharyngeal secretions was common.

In these instances the use of steroids and antibiotics had failed to halt stricture formation. The time interval between ingestion of the caustic substance and the first stage of the operation varied from nine months to six years.

All five cases which were followed for a period as long as one and one-half years, manifested excellent deglutition and voice function. No postoperative dilatations have been necessary. It is significant that these patients ingest all types of foods and have gained weight. (See Fig. 8.) Accidental aspiration has not occurred.

## DISCUSSION.

Although this reported series of patients represents the most advanced stage of combined pharyngeal and esophageal stenosis, it is well to point out that lesser degrees of pharyngeal involvement may be easily overlooked at the time of esophagoscopy. In these instances, when the usual substitution procedures are performed for an obvious lesion of the esophagus itself, normal deglutition will not be established; thus, accurate preoperative evaluation is of paramount importance.

It is not our purpose to discuss the merits of steroids or endoscopic dilatations in early burns of the esophagus to prevent stricture formation. In established esophageal stenosis, it is our opinion that conservative measures should be used only if infrequent dilatations are necessary to maintain reasonable function. When long spiral strictures require frequent and prolonged dilatations, the problem is quite different. Bowel replacement is the preferable method of treatment for intractable esophageal strictures.

The patient with a severe stenosing burn involving both the pharynx and esophagus has presented a frustrating problem in management. In this seemingly hopeless pathologic

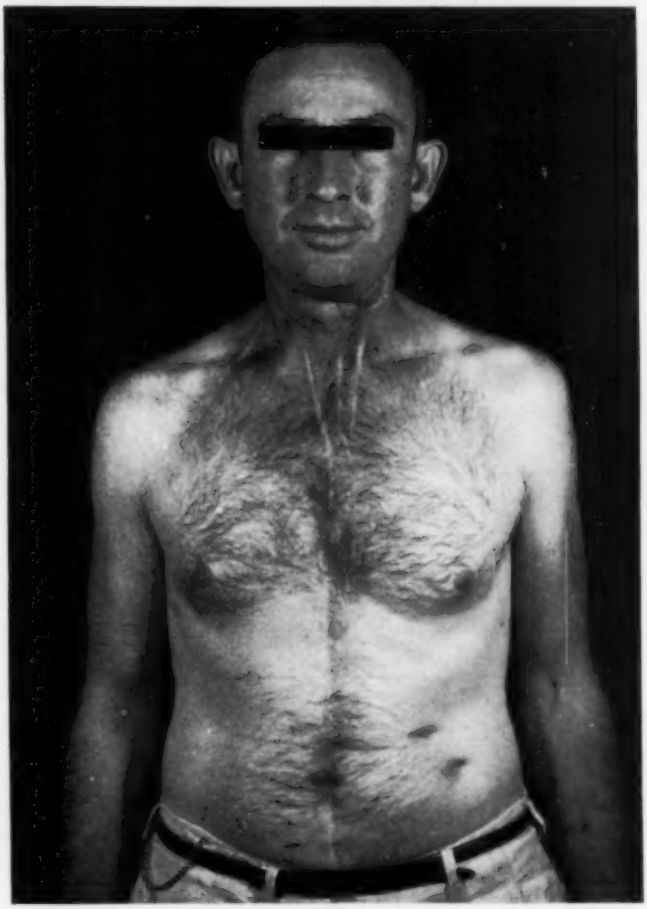

Fig. 8. Appearance of patient 19 months after surgery.

state, permanent gastrostomy has usually been inevitable since pharyngeal and cricopharyngeal scarring could not be overcome by the usual esophageal replacement techniques. Knowledge concerning physiological function retained in the absence of the cricopharyngeal pinchcock and supraglottic structures of the larynx is meager.

Complete cinefluoroscopic studies* and follow-up observations of patients in whom the supraglottic structures and part of the cricopharyngeus have been excised, demonstrate that their removal does not significantly impair deglutition. The total absence of a pinchcock in this series of patients confirms our conclusion that this structure is not necessary for satisfactory swallowing.

This operation is applicable to situations other than strictures due to caustic substances. One 48-year-old woman with a two-year history of symptoms, and not included in this series, presented a long post-cricoid stricture of the esophagus which was complicated by a tracheo-esophageal fistula and complete bilateral vocal cord paralysis.

A previous attempt at local repair was unsuccessful. In this patient, the cecum was anastomosed to the pharynx and a secondary plastic repair of the vocal cords was performed. While hoarseness of voice has persisted, deglutition has been excellent.

From this reported series of patients with pathologic derangement previously considered hopeless, it is evident that such a situation may be overcome by combined service cooperation. The success of this operation should be measured in terms of complete restitution of function. A most gratifying dividend in these patients has been the return to a normal psychological and sociological state.

## SUMMARY AND CONCLUSIONS.

A series of patients with extensive stenosing caustic burns involving both pharynx and esophagus has undergone a

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combined operative procedure consisting of esophageal substitution by the right colon together with plastic reconstruction of the pharynx. The results have been uniformly successful.

The major functions of the larynx and deglutition are well preserved with the absence of the supraglottic structures of the larynx and the cricopharyngeal pinchcock.

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## COURSE IN LARYNGOLOGY AND BRONCHOESOPHAGOLOGY.

**October 23 to November 4, 1961.**

The Department of Otolaryngology, University of Illinois College of Medicine, will conduct a postgraduate course in Laryngology and Bronchoesophagology from October 23 through November 4, 1961, under the direction of Paul H. Holinger, M.D.

Registration will be limited to 15 physicians who will receive instruction by means of animal demonstrations and practice in bronchoscopy and esophagoscopy, diagnostic and surgical clinics, as well as didactic lectures.

Interested registrants will please write directly to the Department of Otolaryngology, University of Illinois College of Medicine, 1853 West Polk Street, Chicago 12, Illinois.

# FOREIGN BODY COMPLICATIONS.*†

PAUL G. BUNKER, M.D. (By Invitation),

Aberdeen, South Dakota.

To me, the subject of foreign bodies in the air and food passages has always been a fascinating one. The removal of such foreign bodies is frequently dramatic and always deeply rewarding in a personal sense, except in those rare tragic cases that are beyond one's skill. If allowed to remain, any foreign body in the air or food passages would result in complications. For the purpose of this paper I have selected cases for presentation that I feel to be of unusual interest so far as their complications are concerned. As any attempt to cover the entire subject would require much more than the allotted time, this paper is based largely on my own experience in this field.

Good roentgenograms are essential to anyone's doing foreign body work. This requires first class and fast equipment plus careful technique and expert interpretation. Many complications such as the various forms of atelectasis and emphysema are clearly identified in the roentgenogram, and serial X-rays may frequently show the progress of existing complications. Contrast media are useful in recognizing nonopaque esophageal foreign bodies or foreign bodies that are obscured by overlying structures. These media can be used in several different methods as follows:

*1.* Direct barium or iodized oil swallow.

*2.* A capsule containing a radiopaque substance. This may absorb at the site of a foreign body and thereby outline it.

*3.* A cotton pledget soaked in iodized oil. This is my favorite method, as it is more likely to catch and be held by an

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†For brevity a number of illustrations have been omitted from this paper.

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impacted foreign body. Not infrequently a small bone will be dislodged by such a pledget and pass harmlessly through the intestinal tract.

4. The use of bismuth in jam is a long time Jackson favorite. I have had no experience with this method, but Dr. Jackson recommended it, particularly in children.

Roentgenograms are often reported as negative in desperately ill patients with an obstructing tracheal foreign body. Such a false and misleading report is usually caused by a bilateral emphysema which could be better demonstrated by fluoroscopic examination. On the basis of such a report where the history or physical examination would definitely suggest a foreign body, one should never postpone bronchoscopic examination.

The introduction of the Holinger and Jesberg infant bronchoscopes has largely done away with the danger of subglottic edema in infants. I was so impressed after using these instruments with the small light bulbs that I had the same style made up in 4, 5, and 6 mm. sizes. The risk of esophageal complications has been reduced by the use of oval esophagoscopes. With these esophagoscopes the operator is less likely to override a foreign body or to perforate the esophagus with the instrument itself. The old style Jackson esophagoscopes, however, are still very useful in selected cases, especially where it is necessary to use the bevelled distal end to dislodge, rotate, or free a foreign body.

Children who are bedridden for other illnesses are particularly prone to put foreign bodies in their mouths. Should this be for a respiratory infection it is often difficult to tell whether the symptoms are the result of the pre-existing infection or a secondary complication of an aspirated foreign body. In a known asthmatic child it is sometimes hard to determine whether the wheeze is the result of a foreign body or part of the bronchial asthma. The rales due to a foreign body are usually coarser and lack the sibilant quality of a true asthmatic bronchitis.

Aspirated vomitus may be a fatal complication. I had such

a case die in a plane enroute to Aberdeen for emergency care. Many of these babies are desperately ill before the aspiration occurs, and they lack the strength to cough out the aspirated material.

A foreign body in a bronchus may induce vomiting as the result of a cough, with secondary aspiration. Recently I had a case which exhibited a partial atelectasis of the lower lobe on the right side with an early emphysema of the middle and upper lobes. This was due to the presence of a chicken bone in a basal segment on the right side, with aspirated vomitus blocking the middle and upper lobes. True foreign bodies can easily be missed in this situation.

The use of proteolytic enzymes (usually in the form of caroids) to facilitate the passage of impacted meat in the esophagus has become a common practice which is not without risk. If proteolytic enzymes are used judiciously, many patients can be spared the discomfort and expense of an esophagoscopy. Dr. Howard Anderson[1] of the Mayo Clinic reported a patient who had been admitted to his service with a diagnosis of perforation of the cervical esophagus following the use of caroids elsewhere. Despite heroic measures the patient subsequently died of a massive hemorrhage from rupture of the common carotid artery. Following this experience Dr. Anderson and his associates, using this preparation, carried out some experimental work on dogs. All the dogs showed severe inflammatory reactions present in the esophagus, and several of the dogs died suddenly of hemorrhagic edema of the lungs resulting from aspiration of the caroid into the air passages. Dr. Anderson's paper was discussed by Dr. John Richardson, who reported 500 cases without complications and by Dr. Robert Priest who, likewise, had no unfortunate experiences with its use. My own routine so far as the use of caroids is concerned is as follows:

*1.* The first time a patient has impacted meat in the esophagus, I always scope him and remove the foreign body in order to inspect the esophagus for any organic obstruction. Not infrequently other pathology such as an early obstructing carcinoma may be discovered by following this rule. If

there is a possibility of a bone's being included in the meat, esophagoscopy should be done.

*2.* Patients who have had this happen with meat are likely to have recurrences. In such cases, if I have been previously satisfied that the esophagus was normal, essence of caroid was prescribed; however, if it does not work in a matter of five or six hours, I then proceed with an esophagoscopy immediately. In my experience morphine is almost as useful by relaxing the esophagus, which occasionally will allow passage of the foreign body, and I do not hesitate to use it in these cases.

I report one case to emphasize the importance of the above routine.

Mr. A, age 79 years, came in with a history of choking on a bolus of pork 12 hours previously. Since that time he had been unable to swallow even liquids. There was very little history of any previous dysphagia, though careful questioning brought out the fact that occasionally he might have to swallow twice to get a large bolus of food down. At esophagoscopy a large mass of meat was removed from a diverticulum which was recognized at the time of esophagoscopy. The meat extended into and completely blocked the lumen of the esophagus as well. An esophagram was made the following day which showed the diverticulum.

I feel quite certain that if proteolytic enzymes had been used in this case, a perforation of the thin walled diverticulum would have resulted.

Respiratory symptoms often predominate and overshadow the esophageal symptoms in an overlooked esophageal foreign body. This can be the result of:

*1.* Direct pressure, as with a marble in the post-cricoid area.

*2.* Peri-esophagitis or cricoid-perichondritis. These conditions may cause laryngeal obstruction and add greatly to the risk in introducing the esophagoscope. It may be necessary to introduce an intratracheal tube to maintain an airway during the esophagoscopy in these cases.

*3.* Spilling of secretions into the tracheo-bronchial tree may cause a severe tracheo-bronchitis or bronchial pneumonia.

4. Various combinations of 1, 2, and 3 may exist in the same patient.

Spasm of the larynx, induced by a foreign body in the larynx, is responsible for most aspirated foreign bodies into the tracheo-bronchial tree. When the patient is finally able to get his breath, the inspiration is so forceful that the foreign body is quickly aspirated. Certain foreign bodies, particularly bay leaves, which stretch across the glottis, have a particular affinity for the larynx. We have had three such cases which were desperately ill until the leaf was removed from the larynx. In some individuals the larynx is quite tolerant, and in others the spasm may quickly fatigue. I recently had a 15-year-old boy who aspirated a sandburr four days previous to my seeing him. His only symptom during this period was inability to talk or even whisper, and during this time he played a complete game of football without trouble. The sandburr was identified and removed from the anterior commissure.

Another complication of an esophageal foreign body is a cervical cellulitis with or without secondary abscess formation. This is usually the result of perforation either from the foreign body or by instrumental attempts at its removal. Surgical drainage may be required if the patient does not respond promptly to conservative measures. Mediastinitis can also occur from perforation of the esophagus. It is important to remember that the dysphagia may be relieved by perforation until such time as signs of mediastinal sepsis appear, much as the pain is relieved temporarily in the case of a ruptured appendix.

Pneumothorax may result from perforation of the esophagus either by the foreign body or the instrumental attempts at its removal. Another less commonly recognized cause of this complication is a spontaneous rupture of the pleura from the positive pressure built up by a severe emphysema.

Emphysema is another common complication which may be divided into two general types:

1. Cervical or mediastinal, as the result of perforation.

This may progress to a point where tracheotomy becomes necessary. I emphasize the importance of a midline incision in this event, leaving the incision open with a very loose pack around the tracheotomy tube. I have seen two such cases develop serious difficulty using a collar incision, and I mention the latter only to deprecate it.

*2.* Emphysema of the parenchyma of the lung itself is the early result of bronchial obstruction. Bronchoscopic removal of the obstruction, whether it be foreign body or mucous plug, is of life-saving importance. If the emphysema of the lung is not relieved, atelectasis, either segmental or massive, will develop. This in turn can lead to bronchiectasis, lung abscess, or emphysema.

Tracheo-esophageal fistulas or bronchio-esophageal fistulas can result from unrecognized foreign bodies. The latter of course would be where the left bronchus crosses the esophagus.

Inflammatory polyps can also develop as the result of unrecognized foreign bodies. I had a 58-year-old man, Mr. M. T. T., who gave a history of swallowing a chicken bone one year prior to my seeing him. The sensation of a foreign body gradually gave way to feeling of a growth in the throat with much discomfort but no pain. He was unable to clear his throat, and in addition he would have severe choking spells. During this interval he was seen by three excellent nose and throat men who missed the diagnosis. I probably would have missed it also, except for the fact that he coughed the polyp up into his hypopharynx while I was examining him with a mirror, and then aspirated it down into the larynx. I removed the polyp by snare from its post-arytenoid attachment, with complete relief of all symptoms.

Not all foreign bodies are accidental, and many are of life-saving importance. They still remain foreign bodies, however, and as such give rise to complications:

*1.* Tracheotomy tube.

*a.* The coldest day we have had in Aberdeen since my location there was a minus 42 degrees. On this particular

day, two tracheotomized patients nearly died from icing up of the tube while out in this weather. Fortunately they were rushed inside where the warm air quickly corrected the situation.

*b.* It is the foreign body reaction of a tracheotomy tube in the trachea that creates decannulating problems. For this reason I designed a decannulating stopple which the patient wears as the final step in our decannulating routine. If the inflammatory reaction induces obstructive signs, the stopple[4] can be quickly removed and the tracheotomy tube reinserted.

*2.* Intubation tubes are still used, particularly in the larger centers, for the relief of laryngeal diphtheria. This commonly results in laryngeal stenosis and may require years of painful and expensive aftercare. Fortunately, we do not see this complication in Dakota, for our doctors do not use this method.

*3.* The intratracheal tube has become an indispensable part of the anesthesiologists' armamentarium, but it can cause death if improperly placed below the carina. Granulomas of the cord, edema of the larynx, especially of the arytenoids, and broken teeth have also been reported. Pneumothorax can result from forced manual respiration with the bag (Kinsella[2]). It is important to prevent biting of the tube, and the lumen of the adapter should be as large as possible.

*4.* Cricoid perichondritis from an indwelling Levin tube is an extremely distressing complication which may require a tracheotomy for relief. I once drove over 100 miles in a blizzard to perform this surgery on just such a case. These cases are doomed to wear a tracheotomy tube the rest of their lives or submit to extensive plastic surgery on the larynx. Drs. Iglauer and Molt[3] presented an interesting series of these cases and called attention to the fact that there is usually pain at the cricoid level prior to the onset of any obstructive symptoms. This should always serve as a warning to the attending surgeon. Fortunately, this complication in the severe form is comparatively rare. I do believe, however, that it occurs in a milder form quite frequently, in

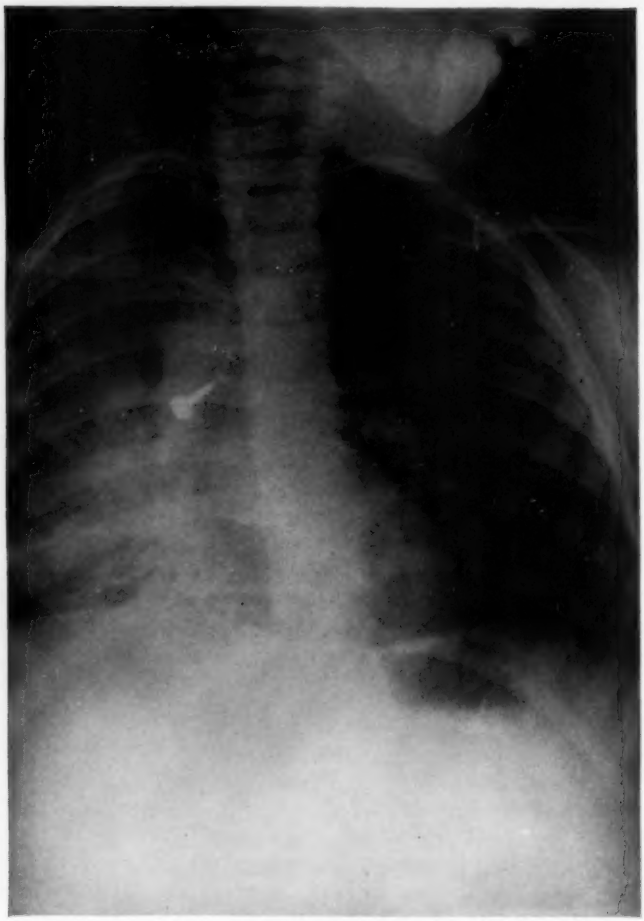


Fig. 1, Case 1. J.K., age 3 years. Tack in right main bronchus with segmental atelectasis—seven months' duration. Note fluid level at right costophrenic angle.

which the only complaint is that of low grade chronic sore throat at the cricoid level.

*5.* Plastic feeding tubes are also useful in inoperable cancer of the esophagus. Mr. C. M. was such a case in which it was impossible to resect the carcinoma because of a dilated and sclerotic aorta. A plastic feeding tube was introduced, and he was able to swallow all foods and medication without discomfort until his death occurred six months later of a gen-

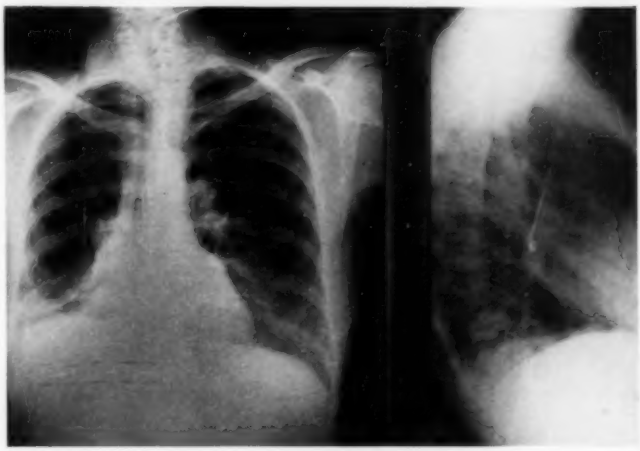


Fig. 2, Case 2. Mrs. F.R., age 40 years. Safety pin in right main bronchus—35 years' duration. Atelectasis of right lower lobe present with lung volume deficit on right side and increased vital capacity on left.

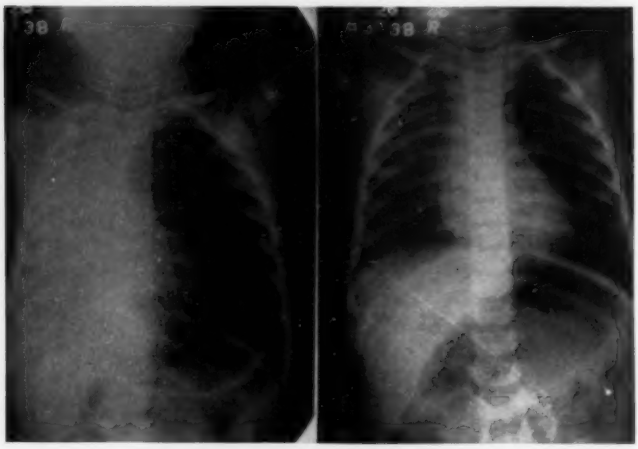
eralized metastasis. He had no discomfort referable to the tube. I know that there are certain complications as the result of these tubes, but I feel that they are definitely worthy of a trial.

*Foreign Body Cases With Complications:*

*Case 1.* Tack in right main bronchus—seven months' duration. J. K., age three years, gave a history of a persistent cough of seven months' duration but with no associated wheeze. This had been diagnosed as pertussis which did not respond to treatment. Later she developed measles with a high fever, and a roentgenogram taken at this time showed a tack present in the right main bronchus, with a localized

atelectasis and possibly some cavitation. At bronchoscopy the point was found to be buried in the bronchial wall and surrounded by granulation tissue. The tack was removed with a Tucker forceps, and she made a gradual but complete recovery. Fluid was also seen in the pleural space.

*Case 2.* Safety pin in right main bronchus—35 years' duration. Mrs. F. R., age 40 years, gave a history of chronic cough, dyspnea, hemoptysis and low grade fever since the age of five years. There was no known history of foreign body, and during this long period of time she had passed through four pregnancies uneventfully. Tuberculosis had been suspected but had never been proven. She finally consulted Dr. C. E. Lowe of Mobridge, South Dakota, who took an X-ray. This disclosed the



a. b.

Fig. 3. Case 3. V.T., age 13 months. a. Massive atelectasis of right lung due to bean blocking right main bronchus. b. After-ray taken five minutes later following removal of bean shows atelectasis completely relieved.

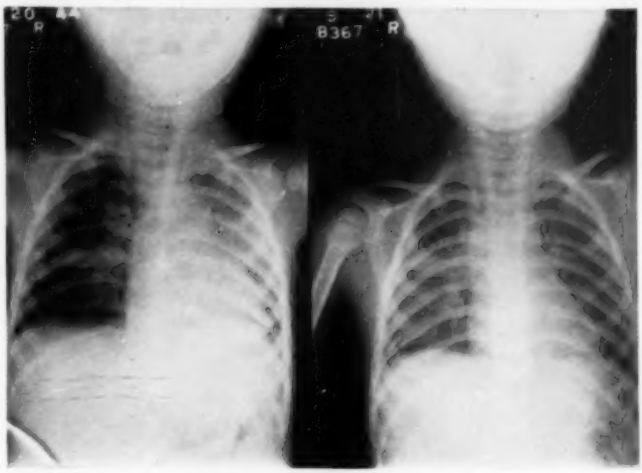
pointed shaft and ring of a large safety pin present in the right main bronchus. The lower lobe on this side was atelectatic. In addition, she showed a lung volume deficit in the right side with a greatly increased vital capacity on the left. There also was a marked secondary scoliosis of her spine. She had no further hemoptysis following the removal of the pin, and her sputum and other symptoms subsided to a point where she was unwilling to consider surgery.

I now report four cases of massive atelectasis in which the X-ray findings are identical but which differ clinically.

*Case 3.* The first case is a 13-month-old girl who was rushed to Aberdeen, a distance of 200 miles by plane, with a history of aspirating a bean six hours previously. Oxygen was administered enroute, and she was a desperately ill baby at the time of her arrival. A roentgenogram

was taken; but because of the serious condition of the child, I proceeded with the bronchoscopy before getting the report on the film. The bean, which was blocking the right main bronchus, was quickly removed. She was then re-bronchoscoped to aspirate the accumulated mucus. I feel this is important in all vegetable foreign bodies in the tracheo-bronchial tree. The child was then taken back to the X-ray department for another film. The first film showed a massive atelectasis on the right side, which had been completely relieved in a period of five minutes as shown in the after-ray. The clinical picture in this case conformed to the X-ray evidence.

*Case 4.* R. L., age 24 months, aspirated a peanut 24 hours previously. The child was dyspneic and on admission had a pronounced wheeze with




a. b.

Fig. 4, Case 7. G.A., age 18 months. a. Emphysema of right lung with "compression-type" of atelectasis in left due to kernel of corn in right bronchus. b. After-ray shows complete return to normal.

a high fever. X-rays of the chest showed a complete atelectasis of the right lung, the same as in the first case. The right bronchus was full of thick mucus, but no foreign body could be identified on this side. A large peanut was then removed from the left lung. In this case the atelectasis was in the one lung, and the foreign body was in the opposite side. It is possible that the peanut may have been in the right lung first and then coughed up and reaspirated into the left lung, or the atelectasis in the right lung may have been due to secretions spilling over into the right side from the foreign body reaction in the opposite lung.

*Case 5.* M. J., age 17 months, had a history of a severe choking spell while eating some peanuts 24 hours previous to admission. She was extremely cyanotic and markedly dyspneic upon admission. X-rays of the chest showed a massive atelectasis of the left lung. Bronchoscopy

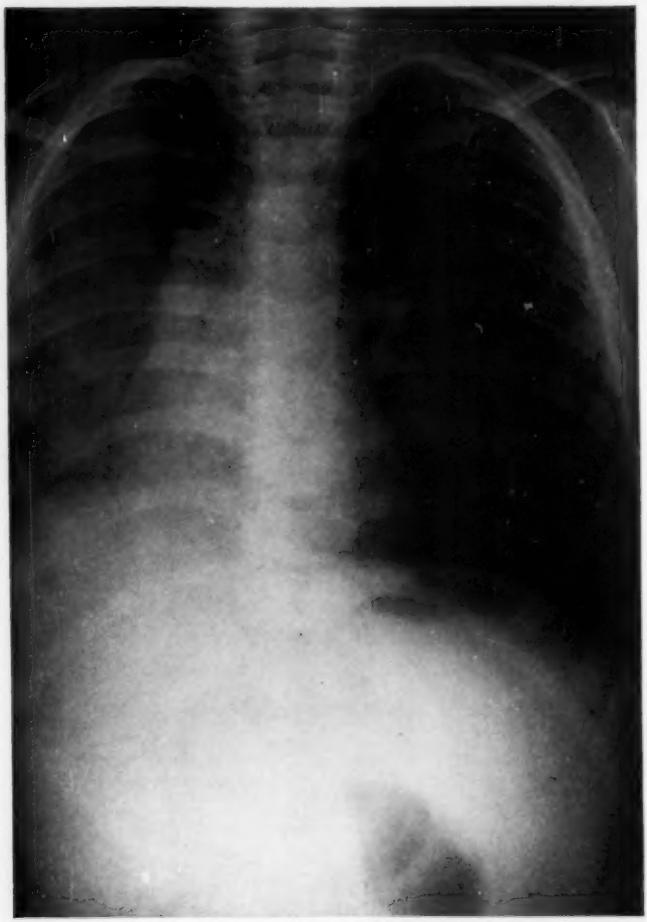


Fig. 5, Case 8. C.K., age two and one-half years. Marked emphysema of left lung with early atelectasis in right due to piece of raw carrot in each main bronchus.

was carried out immediately, and a mucous plug only was found. The peanut apparently had been coughed out, but the choking resulted in the formation of the mucous plug. As shown in the after-ray, she made an uneventful and prompt recovery.

*Case 6.* S. H., 1 year of age. This child presented a history of aspirating a bean. You will note that there is no after-ray on the slide in this case, as the child died practically at the same time the film was made. She lived a distance of 200 miles away from Aberdeen. Her parents stopped about halfway enroute to see an osteopath who told them the child would be all right, and they returned home. About this time her condition became critical, and they began the trip once again to Aberdeen without calling ahead to make arrangements. Consequently further

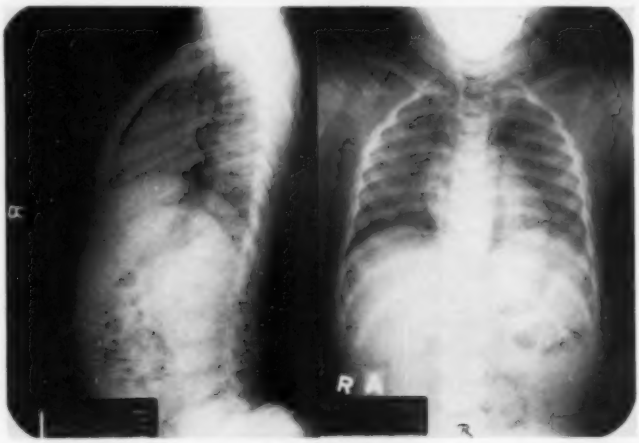



Fig. 6, Case 9. J.R., age two and one-half years. Emphysema of mediastinum and soft tissues of neck secondary to violent choking on popcorn which was coughed out. Bronchoscopy not necessary.

valuable time was lost in locating me. The bean was quickly removed, but the child could not be revived.

*Case 7.* G. A., age 18 months, aspirated a kernel of corn 24 hours previously. She had a pronounced wheeze with rapidly increasing dyspnea on admission. X-rays taken at this time showed a marked emphysema of the right lung with what I choose to call a compression-type of atelectasis in the left. The right lung was tympanitic on percussion. The foreign body was found in the emphysematous lung. That has been my usual experience.

*Case 8.* C. K., age two and one-half years, choked on some raw carrot several hours prior to admission. He was extremely sick upon arrival in the hospital, and X-rays taken at this time showed an emphysema of the left lung and an early atelectasis of the right as manifested by the greatly elevated diaphragm on this side. A large piece of carrot was

removed from each lung with prompt relief of all symptoms. In my experience, a carrot is second only to a bean in the severe reaction it produces. A peanut runs a poor third.

*Case 9.* J. R., age two and one-half years. This child choked on some popcorn two days previously which caused violent and prolonged coughing. This resulted in an emphysema of his neck and mediastinum. When the child was seen at St. Luke's Hospital, the emphysema was present as shown in the X-ray; but the child was asymptomatic otherwise, and the lungs were clear. Bronchoscopy was not done. The emphysema absorbed rapidly, and the baby returned home on the third day. Obviously the foreign body had lodged in the larynx but had been coughed out.


a. b.

Fig. 7, Case 10. A.M., age two years. Peanut removed from right main bronchus. a. Pneumothorax-right secondary to increased positive pressure from emphysema of lung. b. Pneumothorax completely relieved following aspiration of 150 cc. of air from pleural space 36 hours later.

*Case 10.* A. M., age two years, choked on a peanut four days prior to admission. Following this he developed a severe cough with increasing dyspnea and wheezing. He had a temperature of 104.5° on admission to the hospital. X-rays taken by his home physician showed a marked emphysema of the right lung, but unfortunately the film was returned to him before a slide could be made. At bronchoscopy, tenacious bloody mucus was aspirated before the foreign body could be identified. Because of the marked edema of the bronchial mucosa, it was impossible to pass even a 3½ mm. scope down to the nut. A vasoconstrictor was used, but it did not reduce the edema sufficiently to allow good positioning of the scope. One large peanut and several smaller pieces, however, were removed with complete relief of all symptoms. This case emphasizes the importance of a routine after-ray, as an X-ray taken the following morning showed a pneumothorax on the right side. The child was allowed to rest for a period of 36 hours, following which 150 c.c. of air was aspirated with immediate expansion of the lung. I believe this pneumothorax was

the result of increased positive pressure from his emphysema rather than from any instrumentation.

*Case 11.* Penny in the esophagus—one year's duration. J. M., age 17 months, gave a history of dysphagia for a period of one year prior to admission to St. Luke's Hospital. An X-ray taken by her home physician at this time showed a coin present in the middle third of the esophagus. The removal of the coin was uneventful; but she had developed a stricture, which is clearly shown in the after-ray. Subsequently on four occasions it was necessary to remove impacted meat from the stricture, at which time it would be dilated. She has had no trouble now for a number of years, and I believe that she will have no further difficulty.

*Case 12.* Safety pin in hypopharynx—three and one-half months' duration. G. H., age 11 months, gave a history of marked dysphagia and

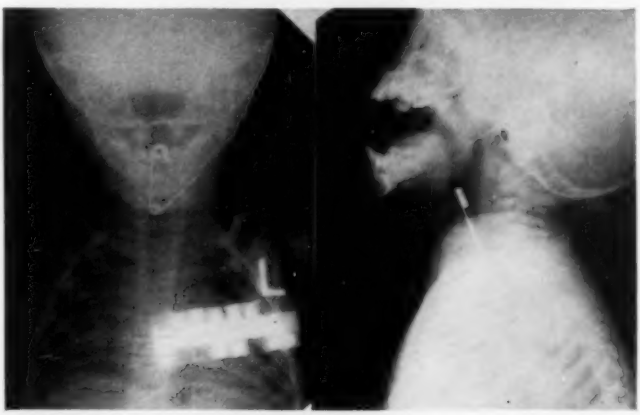


Fig. 8, Case 12. G.H., age 11 months. Safety pin in hypopharynx with cervical cellulitis—three and one-half months' duration.

excessive salivation along with dyspnea in the prone position for three and one-half months. She developed huskiness during the latter part of this period and fever with a cellulitis present in the left side of the neck. During this time she was treated with antibiotics, etc., with only temporary improvement in her condition. Her parents finally took her to Dr. Garberson of Miles City, Montana, who took an X-ray. This revealed a safety pin as shown, and she was referred to me for its removal. The pin was rotated around the tip of the original style anterior commissurescope using the Bunker Technique.[5] The point was embedded in the wall of the hypopharynx; but the pin was removed without difficulty, and no external drainage was required for the cervical cellulitis.

*Case 13.* Button in the esophagus—six months' duration. A. H., age eight and one-half months, gave a history of dysphagia, with severe intermittent respiratory distress and high fever for a period of six months prior to admission to the hospital. Antibiotic therapy was carried out with temporary relief for the acute episodes, only to recur upon her

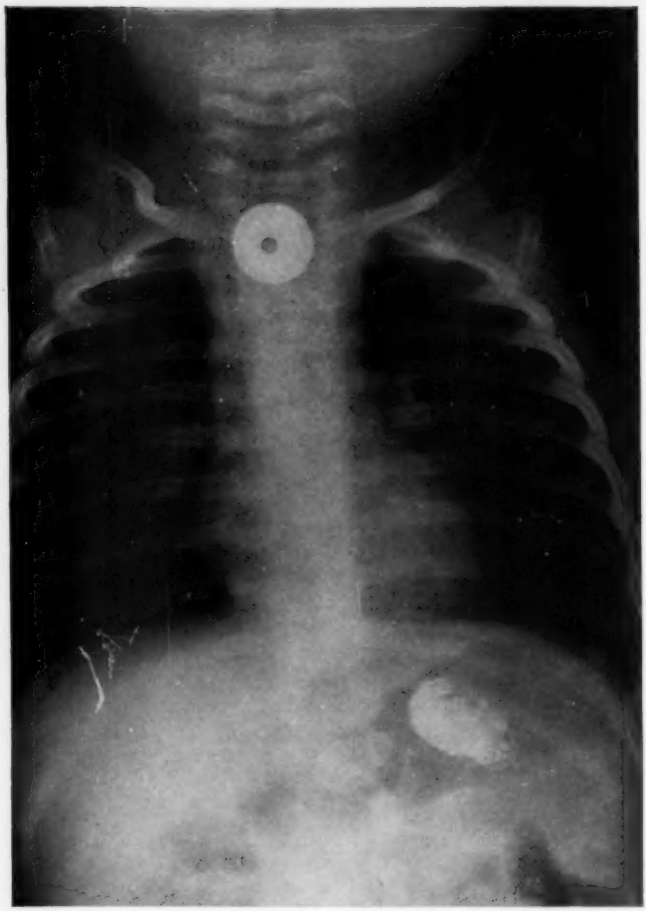
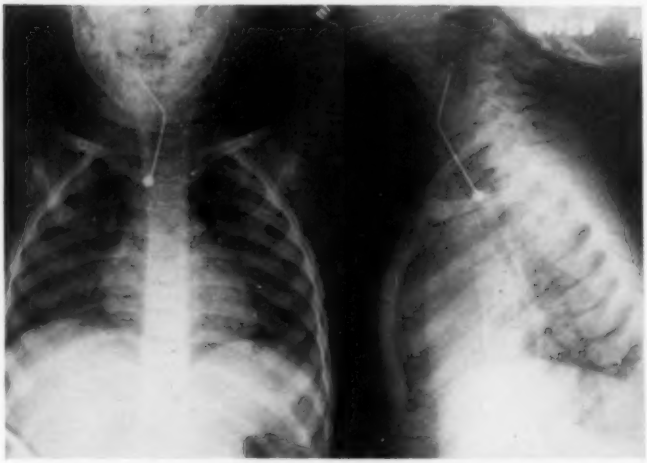
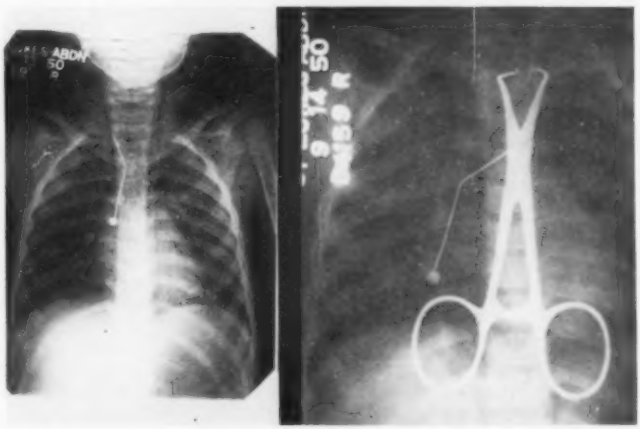


Fig. 9. Case 13. A.H., age eight and one-half months. Button in esophagus—six months' duration with peri-esophagitis.



a. b.

Fig. 10, Case 14, a. and b. D.B., age two years. AP and lateral views show bent hat-pin in trachea with point perforating into neck up to point of angulation.

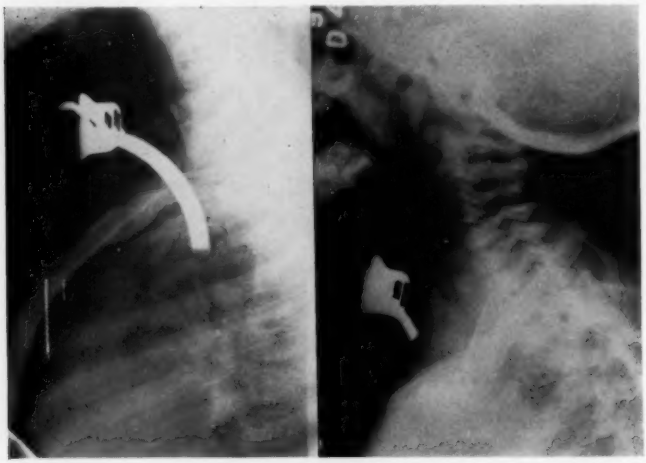


c. d.

Fig. 10 (continued), c. Carrying pin down into right main bronchus to free point resulted in emphysema of neck. d. Pin rotated across bifurcation so that point could be grasped.

return home. X-rays taken by her home physician failed to reveal the button, because his X-ray was not fast enough to stop motion. Our X-rays taken at 1/60 of a second clearly demonstrated it. Because of the peri-esophagitis, removal of the button was rather difficult, as the introduction of the scope into the esophagus caused a cessation of breathing. An intratracheal tube is useful in this situation. The button was removed, and she made an uncomplicated recovery with no secondary stricture formation.

*Case 14.* Bent hat-pin in trachea with perforation. D. B., age two years, was admitted to the hospital with a history of choking on a bent hat-pin several hours prior to admission. I misinterpreted the first



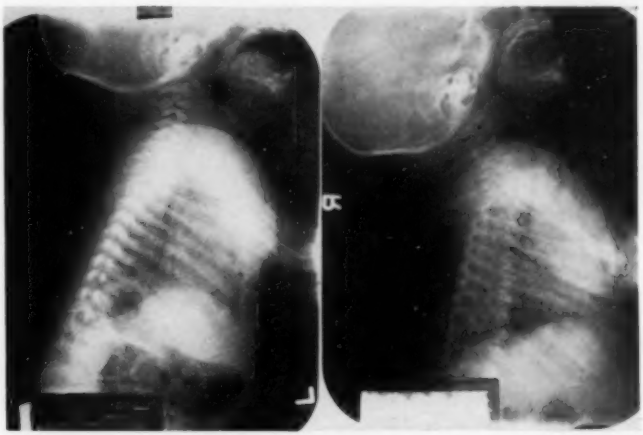
e. f.

Fig. 10 (continued), e. Tracheotomy tube impinging on anterior wall of trachea to embarrass breathing. f. Decannulating stopple in place as final step in my decannulating routine.

roentgenogram and thought that the pin was in the hypopharynx. When I was unable to visualize the pin with the laryngoscope, a lateral film was made which showed the pin in the trachea. Obviously the pin had been aspirated into the tracheo-bronchial tree and coughed up in such manner that the point perforated the tracheal wall up to the point of angulation. The bronchoscope was then introduced and the pin carried down to free the point. At this stage an early emphysema was noted in the cervical area, and the bronchoscopy was discontinued. The emphysema continued to spread so that on the following day it was necessary to do a tracheotomy. Following this the bronchoscope was introduced through the tracheal opening. It was impossible to secure the point so that the pin was then rotated across the bifurcation using a Tucker forceps. It was now possible to grasp the point with the Tucker forceps and then rotate the pin back into the axis of the bronchoscope where it could be safely removed without further manipulation. She had some later difficulty in breathing, and a lateral X-ray of the chest showed the

tracheotomy tube impinging on the anterior wall of the trachea. This was repositioned with relief of her symptoms. The final X-ray shows my decannulating stopple in position which is the last step in our decannulating technique. She developed obstructive signs ten hours after removal of the tracheotomy tube, but it was a simple matter to remove the stopple and reinsert a tracheotomy tube. We have found this a useful instrument in a number of tracheotomy cases.

*Case 15.* Chicken bone in mid-esophagus with secondary perforation. Mrs. J. D., age 50 years, was referred to me by her home physician with a history of high fever, severe chills, and severe back ache for a period of five days prior to admission. There was no definite history of a foreign body, but she stated that she had eaten some chicken the day



a. b.

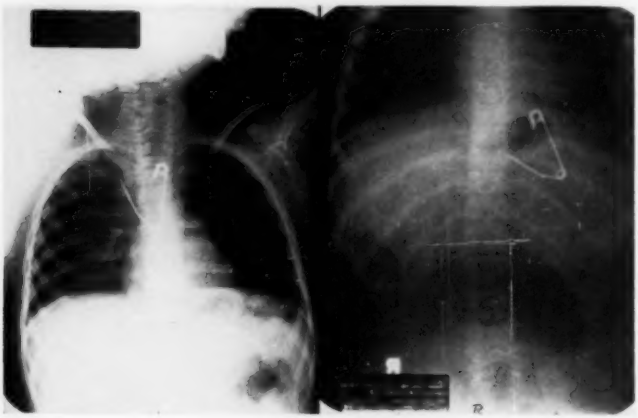
Fig. 11, Case 17. K.J., age two months (my youngest case). a. Shows emphysema of neck resulting from parent's attempt to remove plastic glass from post-arytenoid area. b. Rapid recovery with absorption of air following removal of glass.

preceding her illness. She had had no difficulty in swallowing during this time. The infection was brought under control by antibiotics, at which time X-ray studies, using a capsule of barium, showed an obstruction in the middle third of the esophagus. An esophagoscopy was carried out, and the common triangular piece of chicken bone was found. The entire fan-shaped end had perforated the esophagus so that only the stalk was visible in the lumen. The bone was removed, and the patient made a complete recovery under good supportive treatment.

*Case 16.* Marble in the stomach, one week's duration. P. S., age ten years, gave a history of swallowing a marble one week prior to the onset of treatment. An X-ray taken by his home physician at that time showed the marble in the stomach, and it was believed that it would pass spontaneously; however, an X-ray taken one week later still showed it in the stomach. I include this case in order to report my method of handling retained foreign bodies in the stomach, as it has proven 100 per

cent successful in numerous cases. The child is first fed a bulky meal. Following this, the child is suspended by his feet and vigorous abdominal massage carried out with a pill-rolling motion to stimulate peristalsis. This type of massage is an old-time treatment for chronic constipation. The child is then placed on his right side and maintained in this position for a period of 20 minutes in order to favor passage of the foreign body through the pyloris. Usually the foreign body will pass in a period of 24 to 36 hours, and so it was with this patient.

*Case 17.* Plastic glass in cervical esophagus, with cervical emphysema. K. J., age two months (my youngest case), had a history of having had a broken piece of glass placed in his mouth by an older brother. Removal was attempted unsuccessfully by his parents. Upon arrival at the hos-



a. b.

Fig. 12, Case 18. K.T., age 12 years. a. Shows large safety pin in mid-esophagus with perforating point—six months' duration. b. Pin carried into stomach where it was removed surgically by Drs. C. L. and A. C. Vogele.

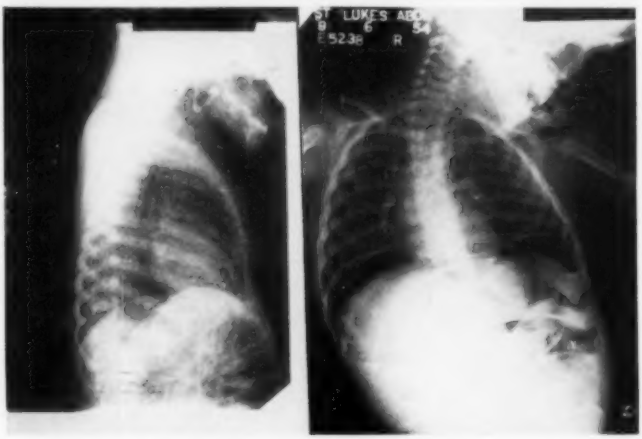
pital, the baby was having marked dyspnea and excessive salivation with evidence of emphysema present in the neck. Lateral X-rays of the neck failed to show the foreign body but did show the emphysema. The foreign body was removed from the post-arytenoid area with prompt relief, and the emphysema cleared up in approximately 48 hours.

*Case 18.* Safety pin in mid-esophagus with perforation. K. T., age 12 years, was an institutional case. She had been a complete invalid since birth with no mental development present. She had had some difficulty in swallowing since a visit to her home six months previously, and she had been unable to swallow even liquids for a period of two weeks prior to admission. X-rays taken at this time showed a large safety pin in the mid-esophagus with the point perforating. Esophagoscopy was carried out immediately. The entire area appeared hemorrhagic and manipulation of the pin was impossible. It was, therefore, carried into the stomach and removed surgically by Drs. C. L. and A. C. Vogele. The

pin was much too large to risk its passing through the intestinal tract without further damage. Her convalescence was essentially negative.

*Case 19.* Safety pin in hypopharynx with death resulting from pneumoperitoneum. G. L. R. gave a history of choking on a safety pin. In my absence from the city another doctor, now deceased, was called to see the child. An X-ray taken at this time showed a small open safety pin in the hypopharynx. Removal of the pin was attempted by him, but it apparently passed on into the stomach. The baby promptly developed pneumoperitoneum, and death resulted two days later from a generalized peritonitis and paralytic ileus.

*Case 20.* Lapel-pin in esophagus with lateral cervical abscess. L. K., age three years, gave a history of having swallowed a pin several hours




a. b.

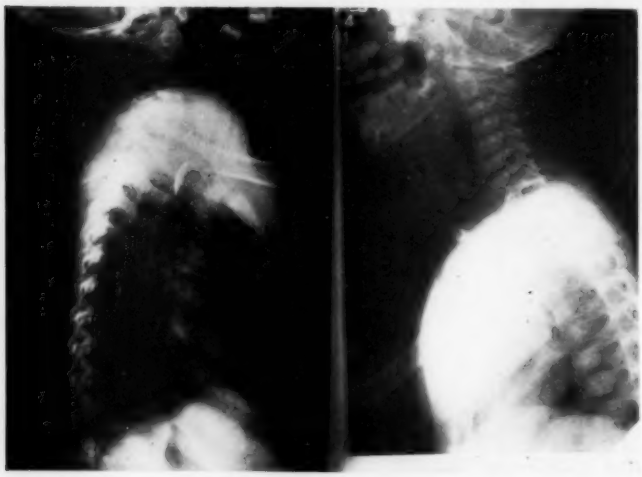
Fig. 13, Case 19, a. Safety pin in hypopharynx (not my case). b. Shows pneumoperitoneum resulting from unsuccessful attempt at removal. Death occurred two days later.

previously. Removal was attempted by his home physician under heavy sedation and with forceps. The child was cyanotic upon admission, so that it was necessary to do a preliminary bronchoscopy with aspiration of the accumulated secretions before esophagoscopy could be carried out. Removal of the pin was simple, but the perforation had already taken place. In spite of all measures the child developed a lateral cervical abscess which required external drainage. In addition, the child had a pneumonitis so that six weeks of expensive hospital care was required before recovery was assured.

*Case 21.* Handle of tea cup with annular edema—right main bronchus. D. M., age four years, presented a history of choking on a broken tea cup handle 36 hours prior to admission. A lateral X-ray showed the handle present in the right main bronchus with a definite annular edema present above the foreign body. The lack of forceps space created by the nature of the foreign body and the annular edema above made

the removal difficult. The stiff expanding forward grasping forceps was indispensable in this situation, and after several applications the foreign body was successfully removed. There were no subsequent complications.

*Case 22.* Overlooked coin in the cervical esophagus with bullet present in stomach. R. H., age 14 months, was playing in the back seat of his parents' car when he suddenly began to choke. The father knew there were some shells present in the back seat and suspected that the child might have choked on one of them. An X-ray taken at this time showed a shell present in the stomach, and his doctor naturally assumed that it would pass spontaneously. The baby, however, continued to have trouble



a. b.

Fig. 14, Case 20. L.K., age three years. a. Lapel pin in esophagus—three hours' duration. b. Emphysema and cervical abscess resulting from blind attempt at removal.

in swallowing and developed signs of respiratory distress. Four days later another X-ray was taken which showed a coin present in the cervical esophagus. I was called to see the baby at this time, and the coin was easily removed. The first X-ray was then re-examined which also showed the coin present in the cervical esophagus, but largely obscured by the marker on the film. His convalescence was uneventful.

*Case 23.* Mr. R. H., age 83 years, I first examined in October 1954, with a history of a transitory type of dysphagia for six months prior to this time. It had been complete for 24 hours before admission. Esophagoscopy was carried out, and a large chicken gizzard was removed from the lower esophagus. An annular carcinoma was suspected at this time, but smear biopsies, etc., were reported as negative. Later fluoroscopic examination showed an extremely tortuous esophagus at this point as the result of a dilated arteriosclerotic aorta. Over the intervening years he continued to have intermittent dysphagia which was usually relieved

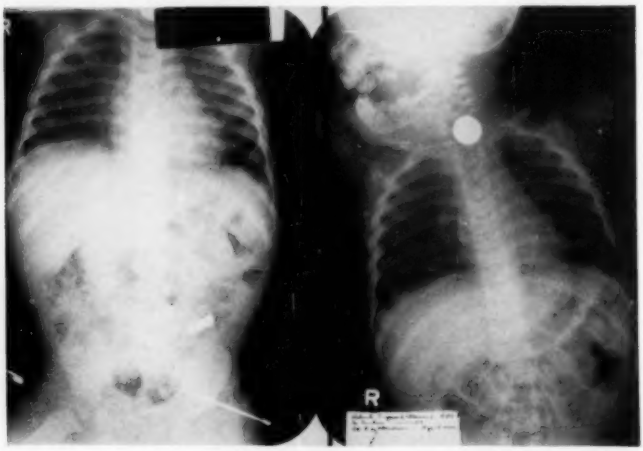
Fig. 15, Case 21. D.M., age four years. Broken handle of tea cup in right main bronchus with annular edema above—36 hours' duration.

by antispasmodics. He had a moderately severe heart attack in April, 1960, and was under treatment for this condition. When next examined on June 6, 1960, he had developed a complete obstruction while eating an orange. Because I was leaving that day for my son's graduation from medical school, I referred him to Dr. H. W. Schmidt of the Mayo Clinic for esophagoscopy. He removed some orange pulp from the obstructed area with good relief. He likewise suspected cancer at this area, but his studies were also negative for this condition. Death occurred suddenly the following afternoon, and the autopsy showed this to have been

caused by a posterior infarct of the left ventricle. There were no complications referable to the foreign body or esophagoscopy.

In conclusion, let me say:

*1.* Foreign body complications can best be eliminated by the proper education of parents in the prevention of these accidents. They should be advised to keep potential foreign bodies beyond the reach of the infant. Nuts should not be given to children under the age of four years as the chewing habit is not firmly established until then.




a. b.

Fig. 16, Case 22. R.H., age 14 months. a. Bullet in stomach with penny in cervical esophagus partly obscured by marker. b. Four days later, bullet has disappeared, but coin is still present.

*2.* Dentists should instruct their denture cases to chew their food carefully before swallowing. These cases should be on guard when eating specially prepared foods such as chicken salad, sandwiches or soups as there may be a bone present.

*3.* Blind instrumentation adds greatly to the hazard of dangerous complications. Careful preliminary study and technique reduces complications. Prompt and proper care of complications is extremely important.

4. One large group of foreign body complications is not discussed. These are the cases of rapid death, which we never see, from unrecognized foreign bodies. As broncho-esophagologists we have a never ending responsibility to keep the family physician and the pediatrician alerted to this possibility. Prompt recognition by them could and does save many lives.

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## SOUTHERN MEDICAL ASSOCIATION, SECTION ON OPHTHALMOLOGY AND OTOLARYNGOLOGY.

The section of Ophthalmology and Otolaryngology of the Southern Medical Association announces that it is now accepting papers by physicians of either specialty, living in the area of the Southern Medical Association, for consideration for presentation at the next annual meeting to be held in Dallas, Texas, from November 6 to 9, 1961.

The paper or an abstract of the paper may be sent directly to the Secretary, Dr. Albert C. Esposito, Suite 1212, First Huntington National Bank Building, Huntington, West Virginia, as soon as possible.

# DOES ACID pH INHIBIT BACTERIAL GROWTH IN THE EXTERNAL EAR CANAL?*

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and
PATRICK G. MCLAIN, M.D. (By Invitation),
Vicksburg, Mississippi.

McBurney and Searcy,[4] in 1936, made a notable contribution with their studies of the effectiveness of fungicidal and bactericidal agents then recommended and employed. Another milestone was passed when the importance of the pH of the normal skin was recognized. Sharlit and Scheer[5] demonstrated the acid reaction of the skin; an improved technique was demonstrated by Blank[1]; Fabricant and Perlstein[3] reported measurements of the pH of the skin of the normal external ear in a series of adults, infants and children, ranging from 5.0 to 7.9, concluding that the pH was "chiefly acid." These reports have been accepted by the profession and, as a logical result, commercial preparations for use in the external ear canal are usually advertised as having an acid pH. Many years ago I read or was told that white vinegar was a good solution to use in the external ear canal, and tried it; not being impressed, I discontinued using it. Of course you know the acid of vinegar is acetic acid. Senturia[6] recommended using hypertonic (3 to 6 per cent) saline to irrigate the canal, but I found that the salt corroded the irrigating tips, and for the past two years have been using 1 per cent acetic acid, with satisfaction. For about the same length of time, I have been prescribing acetic acid in alcohol (36 per cent acetic acid 1 ml., 95 per cent spirits vini rectified qsad 30 ml.) when I wanted a drying solution in the canal.

When discussing the use of acetic acid solutions with Corgill[2] he expressed the opinion that the acetate radical was the

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effective agent. All of this led to my determination to make an investigative study of the effectiveness of acetic acid as a bactericidal agent *in-vitro;* which, in turn, led to investigating an inorganic acid, other organic acids and an alkaline acetate.

## METHOD AND MATERIALS.

A review of cultures from cases of acute infectious external otitis in our laboratory resulted in the selection of the following pathogens for study:

Gram-Negative: Pseudomonas
Proteus
E. Coli
Paracolobactrum

Gram-Positive: Beta-hemolytic staphylococcus
Coagulase-positive non-hemolytic staphylococcus
Streptococcus pyogenes

The latter two were obtained from the University of Mississippi Medical Center Laboratory; the others from our own laboratory.

We did not follow McBurney and Searcy's[4] method of using agar plates, removing a central plug and filling the cavity with the solution to be tested; we had no way of determining the comparative abilities of the solutions to penetrate the agar. We used Trypticase Soy Broth for culture media, compared the turbidity as a measure of bacterial growth, and recorded the pH. All cultures of each group were incubated exactly the same length of time. An inoculated control was run on each group. All solutions were made up with sterile distilled water and sterile technique was employed. Turbidity was computed with the Leitz Photrometer, using two filters 550 and 445; the control was set at 50 for sterile broth and the two readings averaged. We realized turbidity could not be an accurate measure of bacterial growth, but, with the individual pathogens, could have comparative value. The pH

was checked with a Beckman Zeromatic pH Meter. Trypticase Soy Agar in petri dishes was used for plate cultures.

*Experiment No. 1.*

Six cultures were run with each of the seven pathogens. Each tube contained 7 ml. broth, to which was added 1 ml. inoculum; 2 ml. of 5, 10, 15, 20 and 25 per cent acetic acid, respectively, were added to five of the tubes, making the cultures 1, 2, 3, 4, and 5 per cent acetic acid; 2 ml. sterile distilled water were added to the sixth tube as a control. All tubes were incubated at 37° C. for 24 hours; the turbidity and pH of each tube were checked and recorded; pour-plate cultures were made from each tube and incubated for 24 hours. To our surprise, *there was no growth from any of the acetic acid cultures;* of course, there was a profuse growth on each control plate.

*Experiment No. 2.*

While we thought acetic acid would have some bacteriostatic value we had not suspected such weak solutions would be bactericidal, and these results were unexpected. We then determined to see what effect weak dilutions of acetic acid would have on a culture that had been incubated. We discontinued experimenting with 2, 3, and 4 per cent acetic acid, using only the 1 and 5 per cent dilutions. We employed a set of three tubes for each of the seven pathogens, inoculated 7 ml. broth with 1 ml. inoculum and incubated them 24 hours; then added 2 ml. of 5 per cent acetic acid to one tube of each set (making a 1 per cent acetic acid solution), 2 ml. 25 per cent acetic acid to a second tube (making a 5 per cent acetic acid dilution) and 2 ml. sterile distilled water to the third tube, as a control; and incubated the cultures another 24 hours. A pour-plate was made of each, which was incubated an additional 24 hours. Of course, there was a heavy growth on all of the control plates; there was some growth on all of the 1 per cent acetic acid cultures except E. Coli and Streptococcus pyogenes; but *there was no growth on any of the plates inoculated with the 5 per cent acetic acid cultures.*

*Experiment No. 3.*

We then decided to investigate whether an inorganic acid of equal acidity would have the same effect. We chose hydrochloric acid because of its availability, and because it is known to be present in the stomach. We made up two solutions of hydrochloric acid, using the pH Meter, with exactly the same pH as solutions of 5 and 25 per cent acetic acid (pH 2.4 and pH 2.0). We followed the same procedure as in Experiment No. 2, inoculating three sets of cultures with each pathogen and incubating for 24 hours; then adding 2 ml. of the weaker acid dilution to one tube; 2 ml. of stronger acid dilution to the second tube and 2 ml. sterile distilled water to the third tube; and again incubating 24 hours. The turbidity of each tube and the pH were recorded. Pour plates were then inoculated and incubated another 24 hours. *The 24-hour cultures revealed a heavy growth on all plates.*

*Experiment No. 4.*

We decided to repeat this experiment with a mild alkali, and with an acetate solution. We naturally thought of aluminum acetate, but it is not sufficiently soluble. We found sodium acetate fulfilled both of these requirements and made up solutions of 5 and 25 per cent sodium acetate, the pH of these solutions being 7.9 and 8.5 respectively. We followed the procedure employed in Experiment No. 2, using the same pathogens, recording the pH and turbidity, and making pour-plates of each culture. *A heavy growth was found on all plates.* It is interesting to note that the pH of all tubes (after the 48-hour incubation period) was slightly on the acid side.

*Experiments Nos. 5 and 6.*

We then decided to check the *in-vitro* bactericidal value of some other commonly used organic acids. We found benzoic, salicylic and boric acid insufficiently soluble, but both citric and lactic acid fulfilled our requirements in that they are readily available organic acids that are in common use. Again, we made up two solutions of each with a pH equivalent to 5 and 25 per cent acetic acid respectively and fol-

lowed the procedure described in Experiment No. 2, using all seven pathogens. *There was a heavy growth on all plates of the citric acid group. There was growth on all plates of the lactic acid group;* while there were variations from moderate to heavy growth, for the purpose of this study, these variations are of no importance.

*Experiment No. 7.*

Reviewing these results it seemed desirable to know whether still weaker solutions of acetic acid had any bactericidal value when incubated with inoculated cultures. We used a set of three tubes for each pathogen, adding 1 ml. inoculum to 7 ml. broth and 2 ml. of 2.5, 1.25, and 0.5 per cent acetic acid respectively, making the cultures 0.5, 0.25, and 0.1 per cent acetic acid; after incubating 24 hours the turbidity and pH were checked and recorded and pour-plates incubated. There was growth on all plates of the 0.1 per cent acetic acid cultures; growth from 0.25 per cent acetic acid cultures of Pseudomonas, Paracolobactrum, E. Coli, Beta-hemolytic non-coagulase-positive staphylococcus and Streptococcus pyogenes; and growth from 0.5 per cent acetic acid cultures of Proteus, Paracolobactrum and E. Coli. These results are not entirely consistent but do indicate *that solutions of acetic acid weaker than 1 per cent are not consistently bactericidal in-vitro.*

Incidentally, we repeated the cultures of 1 per cent acetic acid in inoculated broth and again had no growth.

## COMMENT.

Table I records the results of Experiment Nos. 1 and 7, wherein varying strengths of acetic acid were added to inoculated broth before incubation. Table II records the results of the other experiments wherein inoculated cultures were incubated 24 hours, two strengths each of the various solutions added and cultured an additional 24 hours.

Mathematical accuracy could not be expected from this type of study, as there are too many variables; however, there are so many variations in turbidity that we cannot accept our method as being accurate. There is less variation

TABLE I.

| | Pseudomonas | | | Proteus | | | E. Coli | | | Paracolobactrum | | | Beta-hemolytic Staphylococcus | | | Coagulase-positive non-hemolytic Staphylococcus | | | Streptococcus Pyogenes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EXPERIMENTS Nos. 1 and 7 | T | pH | C | T | pH | C | T | pH | C | T | pH | C | T | pH | C | T | pH | C | T | pH | C |
| 0.1% Acetic Acid Solution | 28 | 5.2 | + | 39 | 5.2 | + | 20 | 5.5 | + | 24 | 5.3 | + | 25 | 5.4 | + | 26 | 5.3 | + | 28 | 5.2 | + |
| 0.25% Acetic Acid Solution | 43 | 4.5 | + | 40 | 4.6 | – | 31 | 4.5 | + | 31 | 4.5 | + | 23 | 4.5 | + | 40 | 4.5 | – | 28 | 4.5 | + |
| 0.5% Acetic Acid Solution | 40 | 4.2 | – | 36 | 4.2 | + | 35 | 4.2 | + | 32 | 4.3 | + | 41 | 4.2 | – | 40 | 4.3 | – | 40 | 4.2 | – |
| 1% Acetic Acid Solution | 39 | 4.1 | – | 45 | 4.1 | – | 28 | 3.9 | – | 40 | 4.1 | – | 30 | 4.0 | – | 36 | 4.1 | – | 34 | 4.0 | – |
| 2% Acetic Acid Solution | 40 | 3.8 | – | 45 | 3.8 | – | 27 | 3.9 | – | 42 | 3.8 | – | 33 | 3.8 | – | 36 | 3.8 | – | 35 | 3.8 | – |
| 3% Acetic Acid Solution | 40 | 3.7 | – | 45 | 3.7 | – | 27 | 3.6 | – | 38 | 3.7 | – | 33 | 3.6 | – | 37 | 3.7 | – | 35 | 3.6 | – |
| 4% Acetic Acid Solution | 41 | 3.8 | – | 45 | 3.5 | – | 25 | 3.5 | – | 38 | 3.5 | – | 33 | 3.5 | – | 34 | 3.8 | – | 35 | 3.5 | – |
| 5% Acetic Acid Solution | 32 | 3.5 | – | 45 | 3.5 | – | 26 | 3.5 | – | 37 | 3.5 | – | 33 | 3.4 | – | 36 | 3.5 | – | 35 | 3.4 | – |
| Control | 21 | 6.1 | + | 16 | 5.7 | + | 6 | 5.3 | + | 20 | 6.1 | + | 10 | 5.3 | + | 5 | 6.3 | + | 12 | 4.1 | + |

T: turbidity. C: pour-plate cultures.

TABLE II.

| | Pseudomonas | | | Proteus | | | E. Coli | | | Paracolobactrum | | | Beta-hemolytic Staphylococcus | | | Coagulase-positive non-hemolytic staphylococcus | | | Strepto-coccus Pyogenes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EXPERIMENT No. 2 | T | pH | C | T | pH | C | T | pH | C | T | pH | C | T | pH | C | T | pH | C | T | pH | C |
| 1% Acetic Acid Solution | 4 | 4.1 | + | 5 | 4.0 | + | 5 | 4.0 | – | 5 | 4.0 | + | 4 | 4.0 | + | 5 | 4.0 | + | 4 | 4.0 | – |
| 5% Acetic Acid Solution | 5 | 3.4 | – | 5 | 3.4 | – | 5 | 3.4 | – | 5 | 3.4 | – | 4 | 3.4 | – | 3 | 3.4 | – | 4 | 3.4 | – |
| Control | 7 | 5.5 | + | 4 | 6.5 | + | 8 | 6.3 | + | 8 | 6.3 | + | 6 | 6.3 | + | 8 | 6.2 | + | 8 | 6.3 | + |
| EXPERIMENT No. 3 | | | | | | | | | | | | | | | | | | | | | |
| Hydrochloric Acid Solution A | 9 | 6.2 | + | 11 | 6.3 | + | 6 | 6.3 | | 4 | 6.4 | + | 6 | 6.2 | + | 8 | 6.3 | + | 7 | 6.2 | + |
| Hydrochloric Acid Solution B | 7 | 6.5 | + | 10 | 6.2 | + | 5 | 6.4 | | 6 | 6.3 | + | 6 | 6.1 | + | 10 | 5.8 | + | 6 | 6.1 | + |
| Control | 11 | 6.6 | + | 8 | 6.2 | + | 2 | 6.7 | | 6 | 6.3 | + | 6 | 6.2 | + | 4 | 6.3 | + | 7 | 6.3 | + |
| EXPERIMENT No. 4 | | | | | | | | | | | | | | | | | | | | | |
| 1% Sodium Acetate Solution | 9 | 6.6 | + | 12 | 6.5 | + | 7 | 6.6 | + | 13 | 6.5 | + | 10 | 6.5 | + | 5 | 6.8 | + | 10 | 6.5 | + |
| 5% Sodium Acetate Solution | 11 | 6.7 | + | 15 | 6.5 | + | 10 | 6.5 | + | 14 | 6.5 | + | 12 | 6.5 | + | 12 | 6.6 | + | 12 | 6.6 | + |
| Control | 7 | 6.6 | + | 10 | 6.4 | + | 10 | 6.4 | + | 11 | 6.4 | + | 10 | 6.4 | + | 9 | 6.5 | + | 5 | 6.8 | + |
| EXPERIMENTS Nos. 5 and 6 | | | | | | | | | | | | | | | | | | | | | |
| Citric Acid Solution A | 9 | 6.4 | + | 10 | 6.2 | + | 10 | 6.2 | + | 5 | 6.7 | + | 5 | 6.5 | + | 5 | 6.5 | + | 9 | 6.2 | + |
| Citric Acid Solution B | 4 | 6.2 | + | 10 | 5.5 | + | 9 | 5.4 | + | 8 | 5.5 | + | 9 | 5.4 | + | 8 | 5.4 | + | 9 | 5.3 | + |
| Lactic Acid Solution A | 9 | 6.3 | + | 10 | 6.2 | + | 8 | 6.4 | + | 9 | 6.2 | + | 10 | 6.2 | + | 10 | 6.2 | + | 5 | 6.5 | + |
| Lactic Acid Solution B | 5 | 4.1 | + | 3 | 4.0 | + | 6 | 3.9 | + | 5 | 4.0 | + | 4 | 3.9 | + | 6 | 4.0 | + | 7 | 3.9 | + |
| Control | 8 | 6.4 | + | 8 | 6.3 | + | 9 | 6.4 | + | 7 | 6.3 | + | 7 | 6.3 | + | 9 | 6.3 | + | 7 | 6.4 | + |

T: turbidity. C: pour-plate cultures. Solutions A had same pH as 1% Acetic Acid Solution; Solutions B had same pH as 5% Acetic Acid Solution.

in Table I; at least the turbidities of the controls are greater than in the acid solutions; in Table II the turbidity of some of the solutions is greater than in the controls, and that does not seem plausible.

The pH figures show greater conformity. Remembering that a pH of 7.±1 is accepted as neutral, permitting a variation of 0.2 (from 6.9 to 7.1), we consider these figures acceptable.

The most important results are the positive and negative cultures on pour-plates and we feel these findings are reliable.

It should be particularly noted that when sufficient acetic acid was added to cultures at the time of inoculation to make the cultures 1 per cent or stronger, the inoculum was killed during the incubation period, and the pour-plate cultures were negative; further, when sufficient acetic acid was added to 24-hour incubated inoculated cultures to make them 5 per cent and the cultures incubated an additional 24 hours, the pathogens were killed, and the pour-plate cultures were negative.

Too few solutions were tested to draw many conclusions but these *in-vitro* tests with pathogens found in the external ear canal certainly justify the use of acetic acid in preparations for treating infections there; further, the inference can be drawn that the stronger the acetic acid, the more bactericidal the solution.

These experiments were made *in-vitro*, and their *in-vivo* application will require further study.

Appreciation is expressed to Messrs. James B. Grogan and Alfred E. Whitehead of the University of Mississippi Medical Center, Mr. Leslie J. Forsythe of the Vicksburg Hospital Clinical Laboratory and Mrs. Frances Harper of our own laboratory.

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## SIXTH INTERNATIONAL CONGRESS OF AUDIOLOGY.

The Sixth International Congress of Audiology will be held in Leyden, The Netherlands, September 5-8, 1962.

President: Prof. Dr. H. A. E. van Dishoeck;

Secretary: Dr. A. Spoor.

The program will include three round-table talks on "Frequency analysis of the normal and pathological ear." Moderator: Prof. Dr. G. von Békésy. "Central deafness in children." Moderator: Prof. Dr. J. M. Tato. "Psychogenic deafness and simulation." Moderator: Prof. Dr. H. A. E. van Dishoeck, and associated and independent papers.

Official languages of the Congress are: English, French, German and Spanish. Working languages will be: English and French.

For further information address the secretariat, Ear-Nose-Throat Department, Academisch Ziekenhuis, Leyden (The Netherlands).

# VARIATIONS IN THE TEMPORAL BONE COURSE OF THE FACIAL NERVE.*†‡

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New York, N. Y.

For years it has been believed that anomalies of the facial nerve do not occur. This point of view began in the days when every acute otitis media, that did not resolve spontaneously in three weeks, was subjected to simple mastoidectomy.

Occasionally the facial nerve was injured, and since, as a rule, the course has a precise relationship to the prominence of the lateral semicircular canal, it was presumed that the damage was always due to carelessness or lack of surgical skill. Facial nerves were never decompressed and rarely extensively exposed; therefore, it was not really known how often the course of the facial nerve was anomalous in one way or another.

A common argument, for the point of view that variations in the facial nerve do not occur, is based on the paucity of cases described by anatomists and surgeons who have done a large number of temporal bone dissections or museums that have collected them. It must be remembered that the bulk of these dissections have been done on dry temporal bones, and, even here, a complete dissection of the Fallopian canal may not have been carried out. As far as I can ascertain only one anatomist has described an anomalous facial nerve.[1]

Slowly over the years, it became apparent that occasionally the facial nerve does not always follow the course described in otologic textbooks and that there are variations in the

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*Read at the meeting of the Eastern Section, American Laryngological, Rhinological and Otological Society, Inc., Boston, Mass., Jan. 6, 1961, and the 44th Meeting of the Southwest German Ear, Nose and Throat Society, Homburg/Saar, Sept. 23, 1960.

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Fallopian canal. The most common anomaly is one or more dehiscences in the bony canal in its middle ear portion. In the middle ear occasionally there is a prolapse of the nerve itself through these dehiscences. Sometimes there is no outer bone sheath at all. Variations in the course of the chorda tympani occur. There are instances of bony and fibrous narrowings of the stylomastoid foramen (see Fig. 1). I have

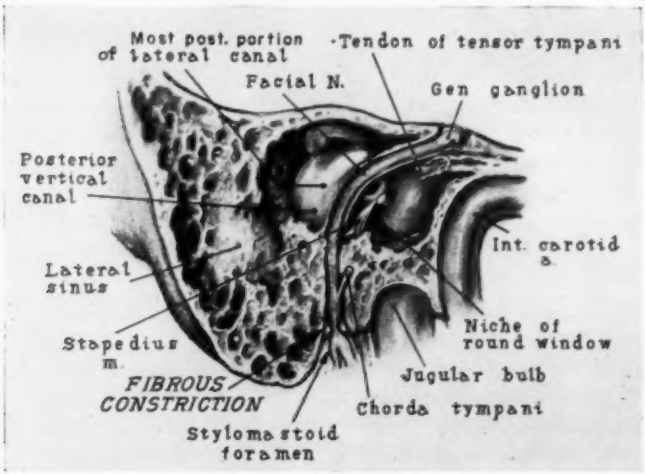


Fig. 1. Topographic anatomy of the course of the seventh cranial nerve within the temporal bone. Fibrous constriction at the stylomastoid foramen as seen in Bell's palsy is also shown.

seen them myself in Bell's palsy cases and they have been reported by Duel,[2] Cawthorne,[3] Collier,[4] Tickle[5] and Kettel.[6] For details on other types of anomalies see Altmann,[7] Alexander and Bénesi,[8] K. H. Hahlbrock,[9] Kettel,[6] Henner, *et al.*,[10] Miehlke,[11] and Botman and Jongkees[12] and Figures 2-6.

Most especially, aberrant positions of the facial nerve occur when anomalies of the first and second branchial arch are present. See Ruedi,[13] Altmann[7] and others. Altmann believes that in such cases there is misbuilding of the mesen-

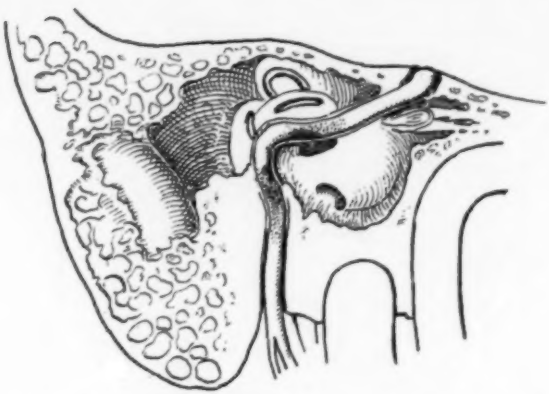

Fig. 2. Facial nerve course—anomalies found with otherwise normal anatomy. a. Most common course anomaly. A hump posterior and lateral to the prominence of the external semicircular canal.

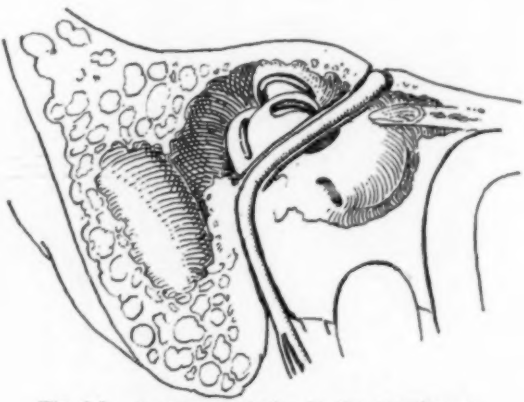

Fig. 2-b. A course anterior to the prominence.

chyme in the early embryo; but, of course, anomalies also occur in otherwise normal temporal bones.

Mr. Angell-James[14] of Bristol tells me that he has seen one case in which the facial nerve ran through the anterior edge of bony external canal, and he has also seen five cases in

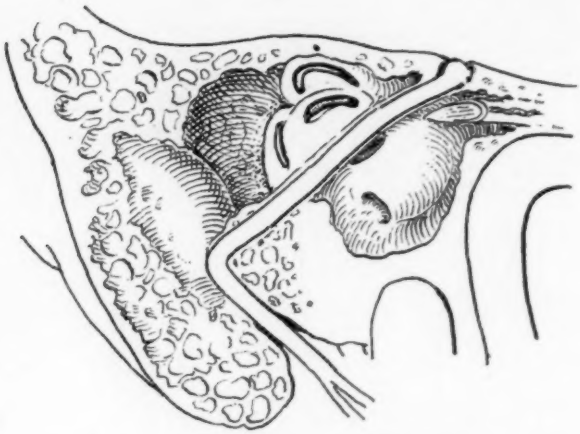

Fig. 2-c. A course posterior to the prominence.

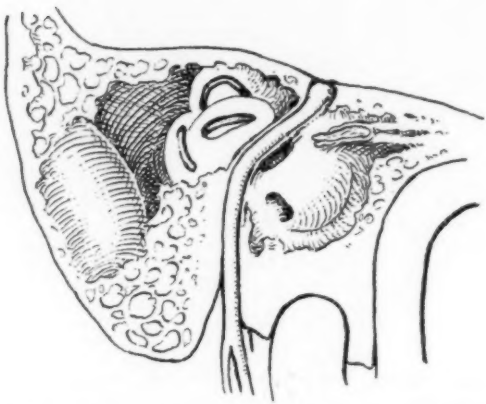

Fig. 2-d. Nerve running straight down the anterior wall.

which there was a lateral "hump" below the external semicircular canal. (See Fig. 2.)

This last is undoubtedly the most common variation in otherwise an anatomically normal temporal bone, Kettel.[6]

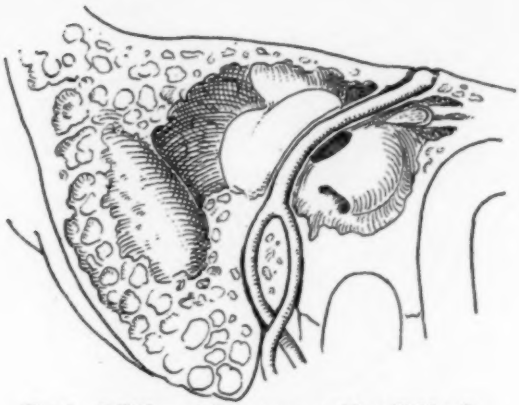

Fig. 3. Splitting of the nerve. a. After Hahlrock.

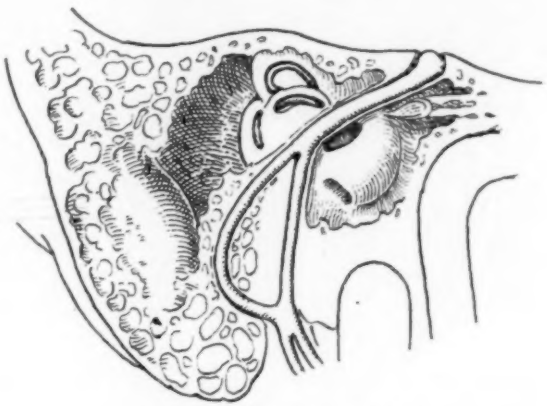

Fig. 3-b. After Pierce-Fowler.

I, too, have twice seen this "hump" anomaly just caudad to the prime landmark for mastoid surgery. In one other case, I suspected an anomaly but could not be sure since the capsule of the nerve had been injured during surgery so that the fibres of the nerve herniated through the perineurium and gave the impression of the hump. I, therefore, felt that

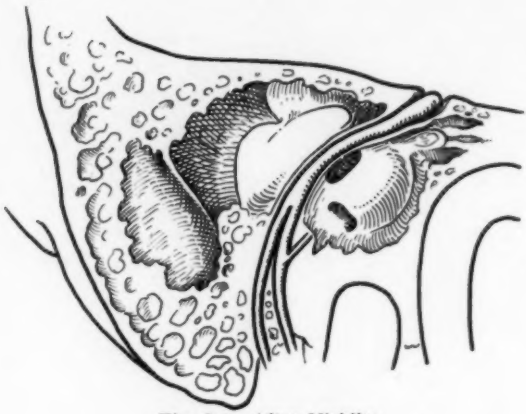

Fig. 3-c. After Miehlke.

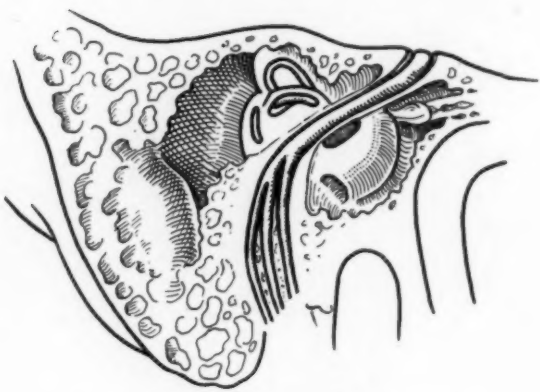

Fig. 3-d. Tripartate nerve after Jongkees.

it was doubtful whether the observed protuberance in the nerve had been present before the injury.

This hump type of anomaly whether it be just between and lateral to the eminence of the canal or just below and posterior to it is probably the most likely one to have been present when a facial nerve has been cut. The ear just below the

lateral canal is the most common site for the nerve to be injured accidentally in any event, Ballance and Duel,[2] Tickle,[5] Fowler.[15] One wonders in how many cases, where the nerve was severed near this site, an anomaly is present. Judging from the fact that a considerable number of facial palsies have occurred in the hands of well known surgeons, in my opinion, it is possible that some of these have been due to a "hump anomaly."

Fig. 4. Posterior position of Nerve VII as seen in a patient with microtia on the same side. Compare Fig. 2-c.

There is very little more that needs to be written here concerning anomalies of the facial nerve. The known types are more important, as shown in the figures, except for dehiscences in the canal. I have collected all of those which I have seen or could find in the literature and made them into comparable diagrams.

All of those in Figure 2 and Figure 3 had no other anomalies present. Figure 4 is similar to Figure 2-c but the course is much further back. A microtia on that side was present in this patient, and it is apparently similar to the case described

by Von Behrens[1] although perhaps a bit lower. Figure 5 shows a course across the promontory. This I observed in a case of congenital stapes fixation, and a similar case has been reported by Henner, *et al.*, in a Treacher-Collins syndrome patient. Figure 6 shows the anomalous course of the chorda tympani in the anterior wall in a case of congenital atresia

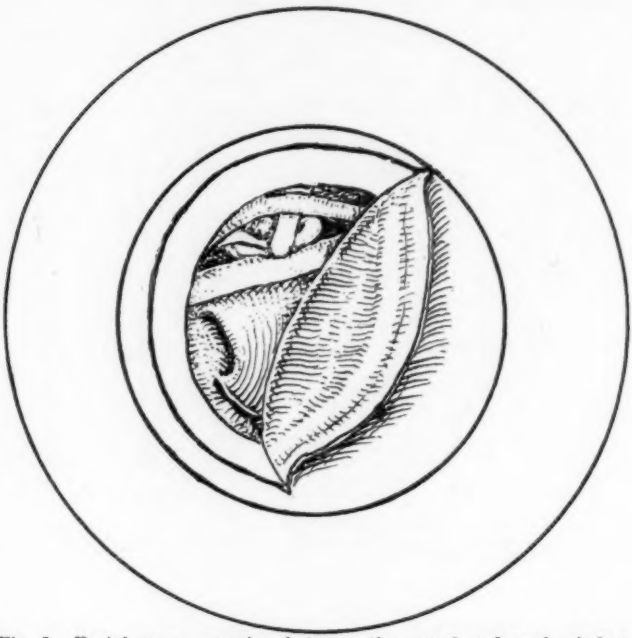

Fig. 5. Facial nerve coursing between the round and oval window in patient with persistent stapedial artery and bilateral congenital stapes footplate fixation.

with a normal auricle. Henner *et al.* mention flattening of the nerve in Treacher-Collins syndrome patients and Ruedi[13] mentions a dropping downwards and a flattening over the bony oval window.

I do not believe I can go so far as Ruedi and say that the facial nerve should always be exposed *in toto* in Treacher-

Collins patients before tympanoplasty procedures are carried out. Certainly if there are branchial fistulae present and especially if there is a severe malformation, it is much more likely that an anomalous course of the facial nerve may be present. If there is any doubt as to where the nerve is, it should be searched for and exposed before it is inadvertently cut.

In conclusion, from this report and others, it is apparent that variations in the relative position of the facial nerve occur

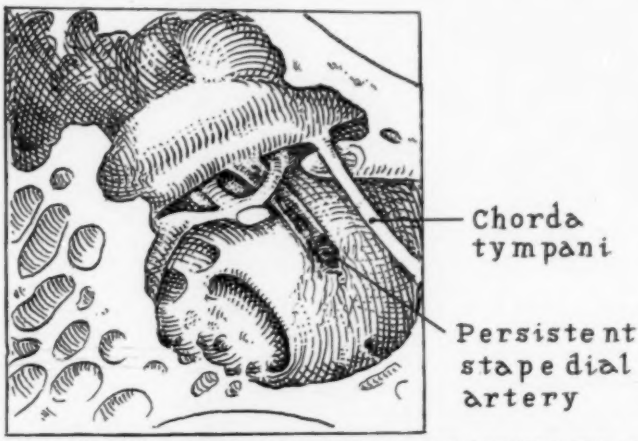


Fig. 6. Anomalous course of the chorda tympani associated with congenital atresia and deformed ossicles on the same side and with microtia on the other.

and, all otologists should bear these variations in mind when doing temporal bone surgery. This means continual instruction to the neophyte that large chunks of bone should never be removed from the posterior canal wall (the so-called facial ridge) with rongeurs, gouges, chisels or burrs. In general, most of the work, especially when nearing the level of the prominence of the horizontal canal, should be done with all strokes parallel to the normal course of the Fallopian canal; never across the normal course even in what is believed to be a normal temporal bone.

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# RESTORATION OF HEARING BY TYMPANOPLASTY.*

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The first consideration of surgery for the chronically infected ear is to eradicate the infection; however, it has become equally important to restore or preserve functional hearing whenever possible. The emphasis of this paper will be upon the latter. This report will consider 75 cases done by the author during the past two years which have had adequate follow-up and sufficient lapse of time following surgery to be included in this study.

It has been hardly a decade since Moritz[1] first described the use of the pedical flaps and Wullstein[2] and Zöllner[3] described the refinements of the surgical technique and defined the two basic physiological principles of tympanoplasty, namely, sound protection for the round window and sound pressure transformation for the oval window. Their brilliant work brought about a revolution in the surgery for the chronically infected ear. There are many excellent reports on the technique in the literature.[4,5,6,7,8,9]

## PREOPERATIVE EXAMINATION.

The patient with a chronically infected ear usually comes to see the otologist because of discomfort in the ear, repeated acute infections, or a drainage that is most often foul smelling. He usually has varying degrees of deafness, but this is not the primary symptom, unless he wishes to get a hearing-aid.

The tympanic membrane, middle ear, and ossicles are examined with magnification. Patency of the auditory tube is determined by Politzer technique using controlled pressure,

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while inspecting the middle ear, or by forcing a fluid from the middle ear through the Eustachian tube into the nasopharynx. Hearing is determined by audiometric test for pure tone and checked with the usual fork tests. Retesting is done with the use of prosthesis of cigarette paper placed over the perforation and/or a cotton pledget saturated with oil and applied to the round window area.

A careful physical examination of the nose, paranasal sinuses and nasopharynx is made. Diseases in these areas should be corrected by medical or surgical treatment before the reconstructive ear surgery is done; however, in certain cases surgery is done in the presence of drainage or infection, and the otologic surgeon must use critical judgment as to whether to delay the reconstructive surgery until some time later. The author has noted clinically that the patients who have a severe respiratory allergy or who have been very heavy smokers for years, are more apt to have difficulty at time of surgery or have more complications of healing following surgery. Roentgenograms of the temporal bones were usually of little benefit in revealing small pathologic changes in the middle ear or epitympanic space.

## TECHNIQUE.

The full thickness post-auricular skin graft, as advocated by Wullstein, was used to cover the middle ear and was extended up along the posterior, superior bony canal wall. The middle ear space was routinely filled with pledgets of gelfoam saturated with a cortisteroid-antibiotic solution. The promontory was denuded of mucous membrane to give an adequate vascular bed to the free skin graft whenever the perforation was greater than 4-5 millimeters in diameter. The skin graft was packed into place with gelfoam, and the cavity was lined with surgical rayon and packed lightly with pieces of a plastic sponge. The packing was removed within ten days, and gentle inflation of the middle ear was started immediately. The pedicle skin flap from the external ear canal wall was used in two suitable cases, and it produced a well healed tympanic membrane. A prosthesis was used to establish the sound

pressure transformation to the oval window in every possible case.

## CLASSIFICATION OF TYMPANOPLASTY.

Any procedure that attempts to describe the various types of pathology found in the chronically infected ear and to coordinate them with the physiologic function following the reconstruction, is often very difficult. I have chosen to follow Zöllner's[10] modification of the classical Wullstein[12] classification.

Wullstein's classification is according to the physiology of the reconstructed middle ear.

A. Sound pressure transformation:

Type I—Perforation in pars tensa and ossicular chain intact and mobile.

Type II—Ossicular chain has a defect but is mobile and functional.

Type III—Stapes intact and mobile, but ossicular connection is disrupted. A shallow middle ear is produced.

B. Sound protection of the round window:

Type IV—All ossicles destroyed including the stapes. A small cavity of the lower part of the middle ear is formed to include the orifice of Eustachian tube and the round window.

Type V—Same as Type IV except that there is fixation of footplate and a fenestra is made in the horizontal semicircular canal.

Zöllner further divides the tympanoplasties of Types II, III, and IV into Class A which designates the large plastic repair of the tympanum, and Class B which designates that lesser plastic repair of the tympanum was necessary. This detailed classification gives a more accurate picture of the extent of the pathology and of the reconstructive surgery, and it helps to predict the functional hearing and allows comparison of the results.[12]

## RESULTS.

First to be considered are Type I tympanoplasties. (See Fig. 1.) This classification is often used synonymously with myringoplasty which implies a simple plastic closure of the tympanic membrane. All too often a careful inspection of the middle ear with the microscope will reveal more disease

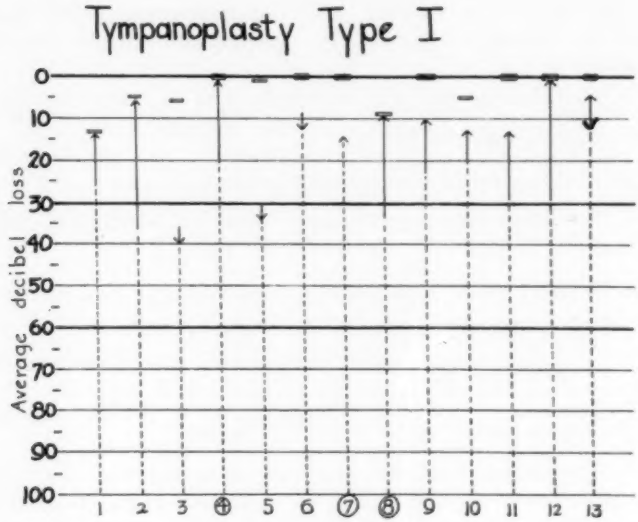
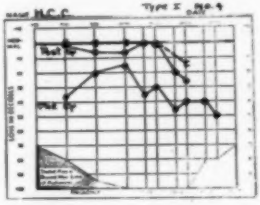



Fig. 1. The heavy black lines represent the average audiometric finding of pure tone for the three speech frequencies (500, 1000, 2000 d.v.) before and after the reconstructive ear surgery. The direction of the arrows represents a gain or loss. The brackets show mean level of hearing by bone at 500, 1000 and 2000 d.v. frequencies. Each case is numbered and the cases selected for more detail study are circled.

than was anticipated by the preoperative examination. There were 13 cases in this series, and the hearing was improved or remained at the same level in nine cases. The air-bone gap was almost closed in all nine cases; however, in four cases the hearing was made a little worse. Cases 4, 7, and 8 were selected for closer study as successful examples of Type I tympanoplasties. (See Fig. 2.)

It is noted that there was considerable pathology in the middle ear of Cases 4 and 8, and it was not a simple perforation of the tympanic membrane.

A large part of the pars tensa was destroyed in Case 7. The diseased tissue was successfully removed in Cases 4 and 8,



**Type I No. 4**

Large perforation in pars tensa.

Removed scar tissue about round window and adhesions to tympanic membrane.

Full thickness post-auricular skin graft used.

Average gain of hearing 18.3 db

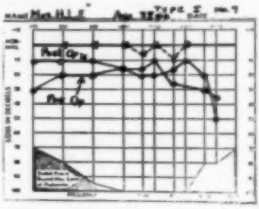
**Type I No. 7**

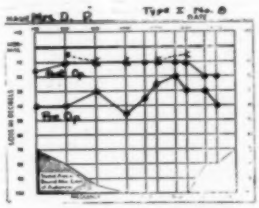
Very large central perforation of pars tensa.

Promontory denuded.

Full thickness post-auricular skin graft used.

Average gain of hearing 0





**Type I No. 8**

Large perforation of pars tensa.

Removed granulation tissue from middle ear and from around stapes to allow good movement. Incised edematous mucous membrane.

Full thickness post auricular skin graft used.

Average gain of hearing 23.3 db

Fig. 2.

and both cases attained a good improvement of hearing with good closure of the air-bone gap. Case 7 which had a larger graft over the middle ear and which had the promontory denuded, obtained no improvement of hearing; but the hearing remained above the 30 db level. All these patients have had a dry ear following the plastic surgery.

There was a total of 17 cases of Type II tympanoplasties, and these were divided into Type A with six cases and Type B with 11 cases. (See Fig. 3.) It is noted that these cases had a greater hearing loss than the first series and that all cases had an improvement of hearing or maintained the same good hearing level above the 30 db level. The air-bone gap was

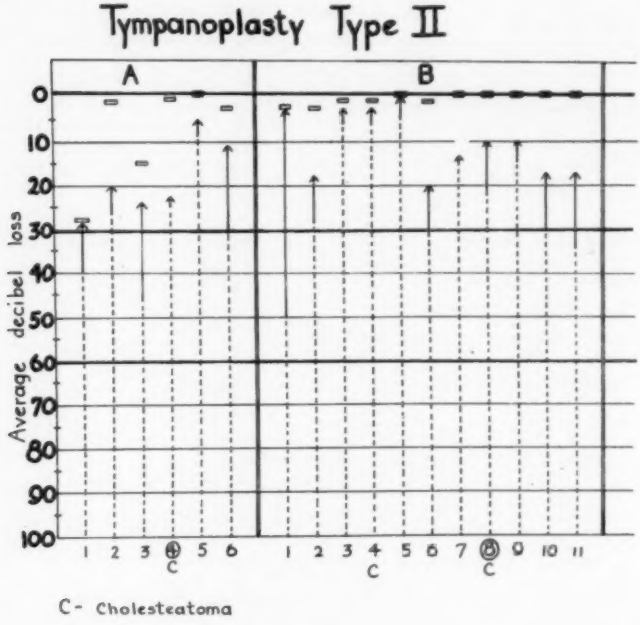


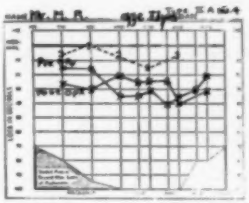

Fig. 3.

closed to within 15 db for four cases in the A group and six cases in B group with a total of ten cases with excellent improvement of hearing.

Two cases that achieved a satisfactory hearing level and were of special interest were selected for more detail study. (See Fig. 4.) Case 4 of Type II A had a cholesteatoma hearing as described by Zöllner[14] with the ball of epithelial mate-

rial acting as a columella between the incus and the footplate. Prior to surgery this patient had had a fluctuating hearing in the left ear. After removal of the cholesteatoma the sound pressure transformation was maintained at the same level with a prosthesis of stainless steel wire which was attached to the long process of the incus and was set upon the footplate.

Case 8 of Type II B showed a similar type of chronically infected ear in which only the lenticular process of the incus



**Type II A No. 4**

Cholesteatoma present and producing columella effect. Posterior half of tympanic membrane destroyed. Stapes and long process of incus eroded.

Prosthesis of stainless steel wire from incus to footplate.

Full thickness post-auricular skin graft used.

Average hearing gain 1.6 db.

**Type II B No. 8**

Small cholesteatoma in posterior superior part of middle ear. Posterior third of tympanic membrane destroyed. Lenticular process of incus eroded.

Removed granulation tissue and cholesteatoma from stapes.

Full thickness post-auricular skin graft used.

Average hearing gain 11.6 db.

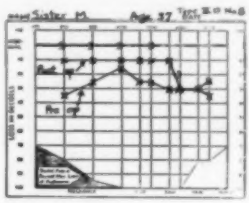


Fig. 4.

was destroyed. Following reconstructive surgery, this patient had 11.6 db gain of hearing.

There was a total of 21 cases classified as Type III tympanoplasty and they were subdivided into Class A with six cases and Class B with 15 cases. (See Fig. 5.) It will be noted that a larger number of these ears have been damaged by the chronic infection and have a greater loss of hearing. Sixteen cases were found to have cholesteatoma, which was usually extensive at the time of surgery. All but two cases had an improvement of hearing from the reconstructive middle ear surgery. Sixteen of the total cases reached the

30 db level; however, only two of these good results were found in Type III A. There were six cases, all in the Type III B, in which the air-bone gap closed to within 15 db. A prosthesis was used in Cases 2, 5, and 15 to convert them from a Type IV to a Type III B.

Case 6 from Type III A and Case 2 from Type III B were selected for more detailed study. (See Fig. 6.) Case 6 dem-

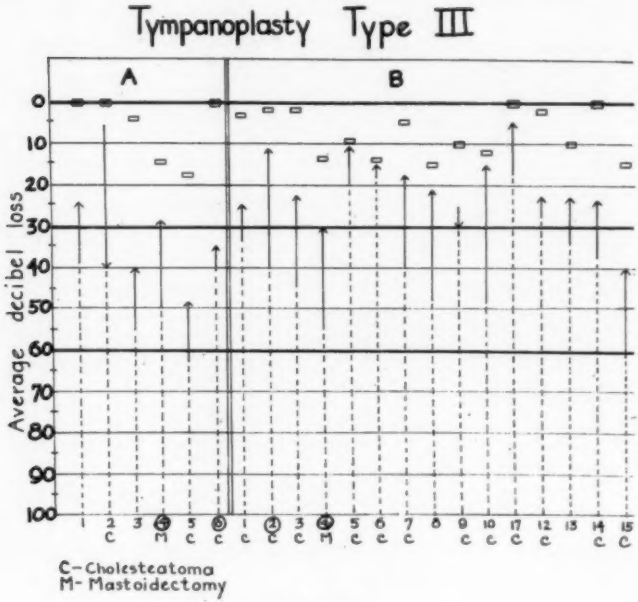
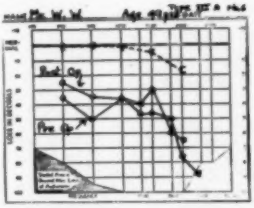



Fig. 5.

onstrates the difficulty of achieving a good improvement of hearing with the total plastic repair. Case 2 shows excellent improvement of hearing obtained by the use of prosthesis of polyethylene tubing as a substitute for the stapes to give sound pressure transformation from the tympanic membrane to the footplate.

Radical mastoidectomy cavities that have been draining for

years may be repaired by the reconstructive middle ear surgery technique. (See Fig. 7.) Case 4 of Types III A and B were selected as examples of successful treatment for this condition. It will be noted that both cases achieved a good improvement of hearing up to the 30 db level which has been maintained for over six months. Both cases now have dry ears.



**Type III A No. 6**
Cholesteatoma present with destruction of incus and partial destruction of crus of stapes. Almost all of tympanic membrane gone. Granulation tissue and polypoid mucous membrane filling middle ear.

Full thickness post-auricular skin graft used.

Average hearing gain 5 db.

**Type III B No. 2**
Large attic perforation with cholesteatoma and destruction of stapes, incus and head of malleus. Head of stapes adhered to pars tensa.

Prosthesis with polyethylene tube No. 90 from pars tensa to footplate.

Full thickness post-auricular skin graft used.

Average hearing gain 28.3 db.

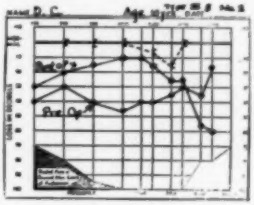


Fig. 6.

Almost all the cases of Type IV tympanoplasty had extensive chronic disease and severe deafness. (See Fig. 8.) From a total of 24 cases, 22 ears had extensive cholesteatoma, one patient had tympanosclerosis of the middle ear, and one had had radical mastoidectomy surgery done many years before, with continued drainage from the ear. There was no marked difference between the A and B groups of Type IV as was demonstrated in the diagram. In this group of cases, there were more patients with extensive disease of the middle ear and mastoid area; hence, there were more cases requiring total plastic repair; nevertheless, 14 of the 24 cases showed some improvement of hearing after surgery, but the hearing attained was not sufficient for social adequacy. Only

seven cases reached the theoretical 30 db level. Some of the patients whose hearing did not reach the 30 db level were happy with their improvement of hearing, because they could now locate sound and some stated that they could now hear conversation better. The hearing was made worse in ten cases but only one of these individuals was conscious of a decrease in hearing. It is most interesting that five cases

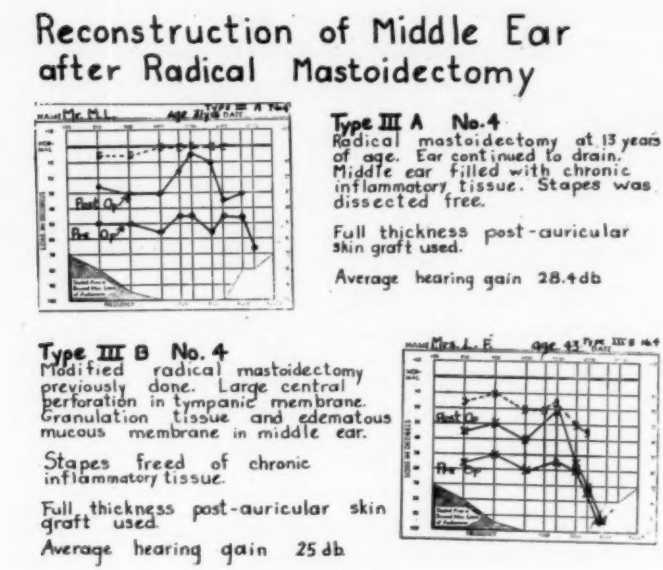



Fig. 7.

were able to hear well above the theoretical 30 db level, and I have no explanation for this other than that the acoustics of the diseased ear differ from the normal ear in physiology, and factors other than sound protection of the round window must be present. I am unable to explain the excellent closure of the air-bone gap in Case 8 of Type IV B except that the disease had created a fenestra in the horizontal semicircular canal.

A more detailed study is shown in two cases that achieved or maintained a satisfactory level of hearing. (See Fig. 9.) In Case 1 a small closed middle ear was created with the large skin graft after cholesteatoma, granulation tissue and adhesions were removed from the windows, the hypotympanic space and the opening of the auditory tube. This gave sound

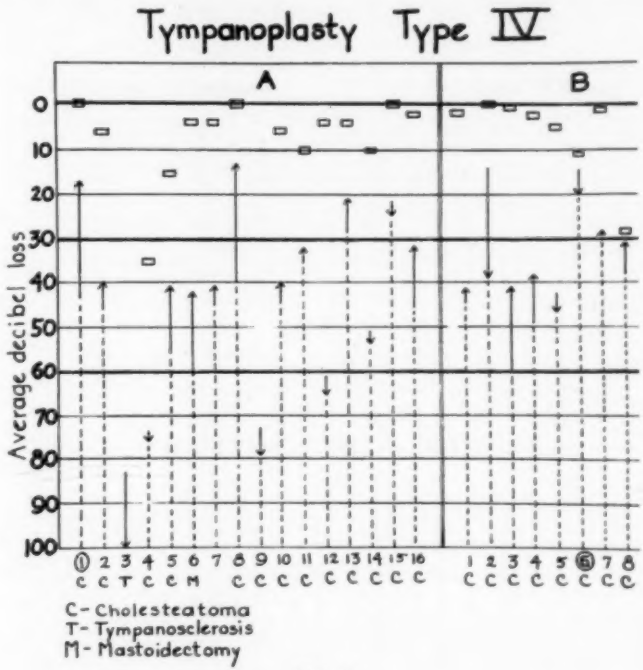
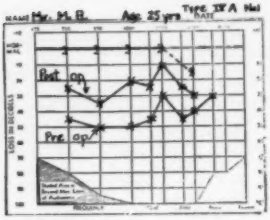



Fig. 8.

protection to the round window with the theoretical maximal improvement of hearing.

It is interesting to note that in Case 6 a good level of hearing was maintained following surgical eradication of cholesteatoma and other disease tissue from the middle ear and mastoid area. This case has maintained a hearing level above the 30 db level.




**Type IV A No. 1**

Cholesteatoma and granulation tissue with extensive destruction of mucous membrane of middle ear and ossicles. Lower half of pars tensa adhered to medial wall.

Hypotympanic space created.

Average hearing gain 21.7 db.

**Type IV B No. 6**

Cholesteatoma present with destruction of ossicles and upper third of tympanic membrane.

Granulation tissue removed from oval window. Hypotympanic space covered with full thickness post-auricular skin graft.

Average hearing loss 3.4 db.

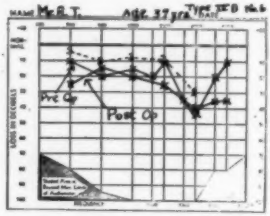



Fig. 9.

TABLE I.

## General Consideration

| Type | I | II | | III | | IV | | Total |
|---|---|---|---|---|---|---|---|---|
| | | A | B | A | B | A | B | |
| No. of Cases | 13 | 6 | 11 (17) | 6 | 15 (21) | 16 | 8 (24) | 75 |
| Cholesteatoma Found at Surgery | 0 | 1 | 2 | 3 | 13 | 14 | 8 | 41 (54.7%) |
| Recurrent Perforations | 2 | 0 | 1 | 1 | 0 | 2 | 2 | 8 (10.6%) |
| Recurrent Cholesteatoma | 0 | | 1 | | | | | 1 |
| Drainage Post Operative | 2 | | 1 | 1 | | | 2 | 6 (8%) |

So far, I have done no cases of Type V tympanoplasties.

RÉSUMÉ.

In Table I the 75 cases studied are listed according to the types of tympanoplasty and these cases are further divided into Class A, if most of the drum is destroyed, or Class B if most of the drum can be preserved. At the time of surgery,

TABLE II.

Hearing Results

| Type | I | II | | III | | IV | | Total |
|---|---|---|---|---|---|---|---|---|
| | | A | B | A | B | A | B | |
| No. of Cases | 13 | 6 | 11 | 6 | 15 | 16 | 8 | 75 |
| Hearing Improved | 9 | 6 | 11 | 5 | 14 | 11 | 3 | 59 (78.6%) |
| Hearing Worse | 4 | 0 | 0 | 1 | 1 | 5 | 5 | 16 (21.4%) |
| Hearing Reached 30db Level | 11 | 6 | 11 | 2 | 14 | 5 | 2 | 51 (68%) |
| Converted with Prosthesis | | 1 | | | 3 | | | 4 |

41 patients (54.7 per cent) had a cholesteatoma and the majority were in Types III and IV. Not all the pathology of the chronically infected ear was diagnosed before surgery, and most certainly the extent of the cholesteatoma was not determined until at the time of surgery. There were eight cases (10.6 per cent) with recurrent perforation; two cases were in Type I, four cases were in Type IV and one case each was in Types II and III. There was one case of recurrent cholesteatoma in Type II B which probably occurred from the skin graft. Six ears (eight per cent) continued to have postoperative drainage from the recurrent perforation.

The hearing results produced by tympanoplasty in this series of 75 patients are shown in Table II. It is noted that a total of 59 cases (78.6 per cent) gained hearing improvement as a result of the reconstructive surgery. It is encouraging to note that there were 51 cases (68 per cent) that reached or maintained a hearing level up to or above the 30 db level. The hearing was made worse by the surgery in a total of 16 cases (21.4 per cent).

Most of the hearing losses were in the severely infected Type IV cases; however, it is surprising to note that there were four cases that had a hearing loss in the Type I tympanoplasty.

There were four cases which were converted from Type IV to Type II or III, with a prosthesis of polyethylene tubing or stainless steel wire resulting in a very good restoration of adequate hearing.

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## EIGHTH ARGENTINE CONGRESS OF BRONCHOESOPHAGOLOGY.

The Eighth Argentine Congress of Bronchoesophagology will be dedicated to the memory of the late Chevalier L. Jackson, M.D., of Philadelphia, Penna. This Congress will be held in Tandil, province of Buenos Aires, Argentina, November 17-20, 1961, under the presidency of Dr. Juan Carlos Arauz, assisted by several foreign physicians. For further information write Dr. Juan Blank, Secretary Cangallo 2150 BsAs, Buenos Aires, Argentina, South America.

# METASTATIC CARCINOMA OF THE NECK OF UNKNOWN PRIMARY ORIGIN.*

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## INTRODUCTION.

There is probably no surgical condition more accessible for easy physical examination yet more difficult to establish a correct diagnosis and definitive treatment, than malignant tumors of unknown primary origin located in the neck. The frequent occurrence of neck masses and reported incidence of 50 per cent attributable to neoplastic disease by Slaughter,[17] and Mayo and Lee,[15] make it imperative that prompt diagnosis and treatment be instituted. The incidence of malignant disease in neck masses rises to nearly 80 per cent if benign thyroid enlargements are discounted[17]; furthermore, if thyroid neoplasms are eliminated, the majority of cervical masses represents metastatic disease. Marinello[12] states that after the fifth decade of life 90 per cent of cervical nodules have a metastatic cancerous origin.

Malignant masses of the neck produce minimal symptoms, no definite pattern, and most commonly are devoid of any significant history. Because of this and despite the obvious location of the mass, less than 20 per cent of patients are seen in the early stage of the disease.[2]

The literature approaches this problem of silent primary carcinoma with metastasis to the neck from various aspects,[1,3,8,9,13,15] but we have found that there is always a group of cases ranging from about 4 to 56 per cent in which

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no primary focus has ever been found. It is with this view in mind that this paper was developed in an effort to clarify this specific area of diagnostic problem.

## SELECTION OF CASES.

This paper presents the findings of 31 cases selected from about 85 case records of the Wadsworth General Medical and Surgical Hospital over a ten-year period (1950-1960) which were treated for a malignant carcinoma in the neck, of unknown primary site. The criteria used to select these cases were: *1.* all cases presented a neck mass on admission; *2.* no previous history of malignancy existed prior to diagnosis of the mass in the neck; *3.* primary site could not be readily determined by history, symptoms, physical findings or pathological diagnosis on biopsy; *4.* no definitive surgery done prior to admission; *5.* definitive treatment (surgery or radiation) was given as a last resort, and the primary site remained obscure.

TABLE I.

| Ages | Cases |
|---|---|
| 34 and under (28) | 1 |
| 35-44 | 2 |
| 45-54 | 10 |
| 55-64 | 8 |
| 65-74 | 8 |
| 75 and over (85) | 2 |
| Total | 31 |

## AGES.

The ages ranged from 28 years for the youngest to 85 years for the oldest. The mean age was 58 years. There were 30 males and one female; 30 Caucasians and one Negro. (See Table I.)

## DURATION OF SYMPTOMS OR SIGNS PRIOR TO ADMISSION.

The average duration of symptoms or signs prior to admis-

sion was 7.7 months. This is comparable to the average duration (6.2 months) reported by Kinsey.[9] The shortest duration was 1½ weeks and one case had knowledge of a submaxillary area swelling for about 10 years. Comess, *et al.*,[3,4] have reported cases of seven, eight, ten and 20 years' duration. (See Table II.)

### LOCATION.

The right was the predominant side of neck metastasis in our series consisting of 17 cases; the left side presented the mass in 11 cases. There were two cases of bilateral neck

TABLE II.

| Duration | Cases |
|---|---|
| 1 month or less | 2 |
| 1 month and less than 2 months | 6 |
| 2 months and less than 3 months | 7 |
| 3 months and less than 6 months | 6 |
| 6 months and less than 1 year | 5 |
| 1 year and less than 2 years | 2 |
| 2 years and over | 1 |
| Unknown | 2 |
| Total | 31 |

masses on admission and one case in the midline. No specific locality of the neck predominated for the neck mass except most presented in the upper cervical nodes. In the cases in which a primary lesion was found, the anterior triangle predominated 9:3 over the posterior triangle of the neck. The primary site was found to be located equally above the clavicle as compared to below the clavicle. There were three cases of metastasis to the posterior triangle in which the primary was found. In each case it was in the lungs.

### SYMPTOMS AND SIGNS.

All 31 cases had a definite palpable mass in the neck. Of these, 41 per cent (19 cases) were completely asymptomatic. Seven cases had tenderness and/or pain, and seven other cases had some degree of weight loss. Other symptoms of

initial complaint (only one case of each) were ulceration of the overlying skin, hoarseness, Horner's Syndrome, fever and general malaise, hemoptysis and hemiparesis.

The neck masses ranged in size from 1 x 2 cm. to 8 x 10 cm. About 50 per cent of the cases had reached 7 x 7 cm. or larger by the time the patient was first seen.

It is interesting to note that the metastatic malignant lesions were found to be mobile in over 50 per cent of the cases. Only one case had involvement on admission.

### ASSOCIATED CONDITION OR DISEASE.

We could find no consistent associated laboratory data, physical findings or disease. There were five cases of arteriosclerotic heart disease; however, this is not too surprising in view of the age group involved in this study.

### DIAGNOSIS.

Every case was a diagnostic problem from onset, due to lack of significant history, symptoms related to specific organ system or physical findings other than the palpable neck mass. Each case was established as a metastatic carcinoma, on biopsy as a last resort. Contrary to the belief of many surgeons that a biopsy is contraindicated in suspected malignancies, it was required to establish the diagnosis that the lesion was, in fact, a malignancy, in view of the completely negative work-up.

The extent of the work-up varied from case to case. Extensive diagnostic measures were employed including upper gastrointestinal series, barium enema, esophagram, intravenous pyelogram, multiple head and neck examinations, direct laryngoscopy, bronchoscopy, multiple biopsies, cystoscopy, skull and sinus series, basal metabolic rate, radioactive iodine studies, and even retroperitoneal air studies in an attempt to locate the primary site.

### TREATMENT.

All of the 31 cases in the course of their work-up were presented to the Head-Neck Conference Staff and to a formal

Tumor Board. In the 11 operated cases, the majority was followed by postoperative radiation therapy. Of the living cases (seven), three were treated with radiation and three were treated with surgery. One case received both surgery and radiation. (See Table III.)

### PATHOLOGICAL DIAGNOSIS.

About 84 per cent of the metastatic lesions were squamous cell carcinomas; nearly 50 per cent of these were well dif-

TABLE III.

Definitive Treatment.

| | | |
|---|---|---|
| Surgery | | 11 |
| Right radical neck dissection | 4 | |
| Left radical neck dissection | 5 | |
| Exploratory (inoperable) | 2 | |
| (Postoperative x-radiation of above cases) | 6 | |
| X-Radiation | | 19 |
| Livingston Lysate (in addition) | 1 | |
| No treatment (deceased) | | 1 |
| Total | | 31 |

ferentiated—a condition which was not expected in the pathogenesis of metastasizing carcinomas. There were four adenocarcinomas, two of which were not recognized on the original biopsy. There was one adamantinoma found at autopsy which was considered squamous cell carcinoma on biopsy of cervical mass. (See Table IV.)

### STATUS AND POST-MORTEM EXAMINATION.

Out of the 31 cases, seven are living, 21 are deceased and three are lost to follow-up at the time of their last known follow-up date. (See Table V.)

The 21 deceased patients died from one and a half months to seven years following initial hospitalization. The average duration was 15 months. The 50 per cent median was eight months. Fifty per cent of the 21 patients expired within

eight months following admission, and all died from their malignancy.

Of the seven cases living, four are free of their malignancy. In six cases no primary has been found; in one case a primary was found at bronchoscopy three months after a right

TABLE IV.

| Cell Type | | Cases |
|---|---|---|
| A. Squamous cell carcinoma | | 26 |
| 1. Well differentiated: | | |
| a. Unknown site | 7 | |
| b. Bronchogenic | 2 | |
| c. Pyriform sinus | 1 | |
| d. Nasopharynx | 1 | |
| e. Tonsil pillar | 1 | |
| 2. Anaplastic: | | |
| a. Unknown | 9 | |
| b. Bronchogenic | 3 | |
| c. Pyriform sinus | 1 | |
| d. Tonsil fossa | 1 | |
| B. Adenocarcinoma | | 4 |
| 1. Unknown | 2 | |
| 2. Breast (Ductal) | 1 | |
| 3. Alveolar cell | 1 | |
| C. Adamantinoma | | 1 |
| Total | | 31 |

TABLE V.

Status and Post-Mortem Examination.

| | |
|---|---|
| Status: | |
| Living | 7 |
| Deceased | 21 |
| Lost to follow-up | 3 |
| Post-Mortem Examination: | |
| No post-mortem examination (refused) | 7 |
| Post-mortem examination | 14 |

radical neck dissection. The average length of follow-up on the living cases is 21 months, ranging from one month to seven and one half years. Three were treated with surgery; one was treated with surgery and X-ray, and three were treated with radiation alone. The longest survivor was treated with surgery alone.

### TIME OF ESTABLISHING PRIMARY SITE.

In 12 cases, a primary focus for the metastatic carcinoma in the neck was found; five during life after definitive therapy, and seven at post mortem. No primary could be found in 16 cases or 51 per cent of this series. Of these 16 cases, six patients are living (four without disease), five were autopsied, but still no primary could be found, and five did not have a post-mortem examination. (See Table VI.)

TABLE VI.

Time of Establishing Primary Site.

| | | |
|---|---|---|
| Time: | | |
| After definitive therapy during life | | 5 |
| Surgery and postop. radiation | 4 | |
| Radiation | 1 | |
| At post mortem | | 7 |
| No primary found | | 16 |
| Lost to follow-up | | 3 |
| Total | | 31 |

### LOCATION OF PRIMARIES, METHOD AND TIME OF DISCOVERY.

There were 12 cases in which a primary site was found for the metastatic lesion in the neck (see Table VII). Of the five cases discovered after surgery two cases were confirmed at autopsy, two had no autopsy and one case is still living. One case was a 47-year-old male who was found to have a left pyriform sinus carcinoma diagnosed by biopsy two years and nine months after surgery, given palliative irradiation and cordotomy for pain. The patient died two months later at which time the diagnosis was confirmed. The second case was a 51-year-old male who was diagnosed as having carcinoma of the nasopharynx ten months following admission, given a course of irradiation and died 21 months later. No post-mortem examination was obtained. The third case was a 48-year-old female found to have a right breast ductal carcinoma 11 months following admission, given additional radiation and confirmed at post mortem four months later. The fourth case was a 63-year-old male with a squamous cell carcinoma of the right anterior pillar one year and five

TABLE VII.

Location of Primaries, Method and Time of Discovery.

| Location | Method | Duration of Neck Mass Prior to Admission | Duration After Initial Admission (or Initial Therapy) | Length of Survival or Follow-Up After Primary Was Found |
|---|---|---|---|---|
| After Definitive Treatment During Life: | | | | |
| Lt. pyriform sinus | Pharyngoscopy Biopsy | 7 months | 2 years, 9 months | 1 month |
| Lt. lung | Bronchoscopy Biopsy | 1 month | 4 months | 1 month |
| Rt. nasopharynx | Nasopharyngoscopy Biopsy | 10 years | 10 months | 23 months |
| Rt. anterior tonsillar pillar | Biopsy | 1 month | 1 year, 7 months | 2 months |
| Rt. breast | Biopsy | 8 months | 1 year, 2 months | 3 months |
| At Post-Mortem Examination: | | | | |
| Rt. pyriform sinus | At post mortem | On admission | 5 months | |
| Lt. lung | At post mortem | 1 month | 4 months | |
| Rt. tonsil fossa | At post mortem | 2 months | 6 months | |
| Lt. lung | At post mortem | 2 months | 4 months | |
| Rt. lung | At post mortem | On admission | 3 months | |
| Rt. mandible | At post mortem | 10 months | 1 year, 4 months | |
| Lt. lung | At post mortem | 1 month | 8 months | |

months after surgery, given radiation and died two months later. No post-mortem examination was obtained. The fifth case was a 47-year-old male who was found to have a left upper lobe lung lesion on bronchoscopy four months after surgery; was given palliative radiation and was last seen, on follow-up one month later, with residual carcinoma.

The average duration from onset of neck mass to the time of diagnosis of a primary site was 23 months. If the 10-year case is excluded, the average length of time was 13 months. Martin and Morfit[13] found that the average delay was about one to two years before the primary source was discovered. When considered from time of admission, our series showed the average duration to be 10.5 months before the primary focus was discovered.

The shortest period in which a primary site was found was three months in a case of a 61-year-old male who was admitted for a possible cerebral vascular accident and a neck mass discovered on admission. The neck mass revealed anaplastic carcinoma, and a bronchogenic carcinoma was found, only at post mortem, in the right lower lobe, as a small focus not detected on multiple chest X-rays. The longest period necessary to establish a primary in our series was two years and nine months, in a 47-year-old male admitted for asymptomatic left neck mass of about seven months' duration. The neck mass revealed squamous cell carcinoma and on repeated head and neck examinations and biopsies the primary site was located in the left pyriform sinus.

This study has revealed that the primary sites are located as follows: pyriform sinus in two cases, tonsillar area in two cases, nasopharynx, mandible and breast one case each. In five cases the primary focus was found in the lung. It is interesting to note that the primary site was located supraclavicularly in 50 per cent of these "never found primary" cases and infraclavicularly in the other 50 per cent; therefore, the primary site was not predominately located in the head and neck area as usually considered.

## DISCUSSION.

This paper is aimed to increase the acuity for detection of head and neck cancer by physicians and dentists, and to stem the delay in referring the patient with cervical masses which may be extremely virulent, rapid growing or even silent. We firmly believe that the most influential factor in the treatment of this disease is the early recognition of the probability of underlying malignancy in the cervical mass. Immediate diagnostic management will usually benefit these patients more than any definitive procedure done at a later date by some other physician.

A review of the literature reveals that very little has been written on the subject, particularly in regard to the very difficult diagnostic cases and the characteristic clinical course of this disease. In this series, all of the cases had no symptoms or signs referable to a primary focus. All cases had a thorough work-up and had either definitive surgery or radiation as a last resort prior to being included in this series. Cases in which a primary site was located after the first few examinations and which had no definitive treatment (the body of all published series) were excluded from this series. This paper approaches this problem from a broad perspective, and time does not allow for detailed expansion on grading of pathological specimens, anatomy of lymphatic drainage, etc., for which specific references are recommended.

In this limited series, the pharynx was found to be the most common site of occult head and neck carcinomas and an equal number (five cases) were found to originate from the lungs.

In a study of all carcinomas with metastasis to the neck, Martin and Romieu[14] found the nasopharynx as the most common site, followed by tonsils, base of tongue, thyroid gland, extrinsic larynx, floor of mouth, palate and pyriform sinus in decreasing frequency. It is also of interest that 10 per cent of the 157 tonsil carcinomas were considered simple tonsillitis and had simple tonsillectomies.[13]

The relationship of various lymph node groups with the

most likely sites of the primary carcinoma when involved with metastasis is well described by Kinsey *et al.*,[9] in which 150 cases of head and neck primaries were correlated with the nodes involved.

In the various types of malignancy of the body, in what per cent can one expect it to present as a cervical mass as the first sign or symptom? Martin and Morfit[13] in a study of all carcinomas with a metastatic lesion in the neck, found that cervical metastasis was the first symptom in 145 of 1867 cases (7.8 per cent) of mouth and pharyngeal primary cancers; seven of 89 cases (8 per cent) of thyroid primary cancers; none in 141 cases of salivary primary cancers; three in 1000 cases (0.03 per cent) of breast cancer; none in 200 cases of stomach and lung cancer; two of 200 cases (1 per cent) of esophagus cancer; two in 74 cases (2.7 per cent) of pancreas primaries; four in 70 cases (5.7 per cent) of kidney and adrenals. Various anatomic sites with primaries below the clavicle as listed above total 11 in 1744 cases or 0.6 per cent. There were 55 in the total 218 silent primary tumor cases (25 per cent) in which no primary could be found. Comess *et al.*,[3] found primary sources also from the ear, maxillary sinus, lung, stomach, prostate, and urinary bladder. In our series, the mandible was also a source of primary lesion; the lung showed a surprisingly high percentage as the primary source.

Martin and Morfit[13] found that in over 50 per cent of the nasopharyngeal carcinomas, the most frequent initial complaint was cervical metastasis. Of particular interest is the fact that approximately two-thirds of the referring and admitting physicians missed the primary lesion. This may be attributed to the fact that a proper nasopharyngeal examination requires special instruments, apparatus, and ability acquired only after considerable experience.

It may be axiomatic to state that a cervical enlargement without obvious cause indicates an immediate investigation for a possible primary malignancy—not a biopsy. After an exhaustive unsuccessful search for a primary focus, the patient should be followed closely for at least five years. The

discovery of a primary focus is, in general, directly proportional to the physician's acuity and self-determination to locate the focus.

## SUMMARY.

Metastatic carcinomas to the neck without a readily detected primary source is discussed and a review of the literature given. Thirty-one selected cases from the records of the Wadsworth General Medical and Surgical Hospital (1950-1960) have been examined with strict criteria, mainly of having had some form of definitive treatment for the cervical metastatic mass without finding the primary. The average age was 58 years and average duration of symptoms prior to admission was 7.7 months. The metastatic lesions were equally as mobile as non-mobile. Squamous cell carcinoma was the predominant type of cervical metastasis. Fifty per cent of the 21 cases expired within eight months following admission. In 12 cases, a primary focus of malignancy was found. Their method, time and location of discovery are discussed. The average duration from time of admission to time of establishing the primary malignancy was 10.5 months. It was found that the infraclavicular primary malignancies were practically equal in number to the supraclavicular lesions in these cases with a metastatic neck carcinoma of unknown primary origin.

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# TRAGAL PERICHONDRIUM AS OVAL WINDOW GRAFT.*†

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The adult stapedial footplate normally presents a vestibular surface lined by perichondrium. The footplate itself is composed of irregular islands of cartilage and bone and is a thin structure with an average thickness of less than 0.2 mm.

The perichondrium which, in a specialized way, constitutes the annular ligament, and that which comprises the medial aspect of the footplate, is very thin and almost acellular. Since it is surrounded by only a very small zone of sub-perichondral tissue and free cartilage, and since the cartilaginous aspect of the footplate may even be partially absent in the adult, it is questionable whether this specialized perichondrium possesses chondro-genetic characteristics. The stapes is an adult bone practically at birth. The acellularity of the very thin footplate perichondrium does not appear to change in otosclerosis. There is no evidence at this time to indicate that the otosclerotic process ever starts in the footplate region. Everything we know seems to indicate that the otic capsule is the site of origin of the disease, and that the footplate is invaded secondarily.

In total stapedectomy the oval window must be closed by a suitable substance to protect the perilymph space. This new oval window seal must be dynamically capable of responding to transmitted acoustic energy via an artificial by-pass device. This prosthetic by-pass may consist either of a plastic or metal strut. A number of substances have been used rather extensively recently in order to close the oval window. These include vein, connective tissue, and fat grafts, and also gel-

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Fig. 1. Cross section of perichondral graft. Note pouch-like conformation of perichondral covering of tragus tip. Note lack of cellular elements and rather homogeneous matrix of collagenous tissue.

foam implants. A few other substances such as acrylics, polyethylene film, cartilage and bone grafts have also been used, but with questionable success. Although results in stapes surgery have improved greatly with the advent of total stapedectomy and oval window grafts, a number of complications are reported which deal primarily with problems affecting

the labyrinth itself. These labyrinthine complications may be divided into the following groups: *1.* persistent oval window fistula, *2.* acute labyrinthitis, with cochlear degeneration, *3.* subacute fibrinous labyrinthitis with cochlear degeneration, *4.* saccular and utricular injuries with positional vertigo, *5.* granulomatous labyrinthitis secondary to or concomitant with

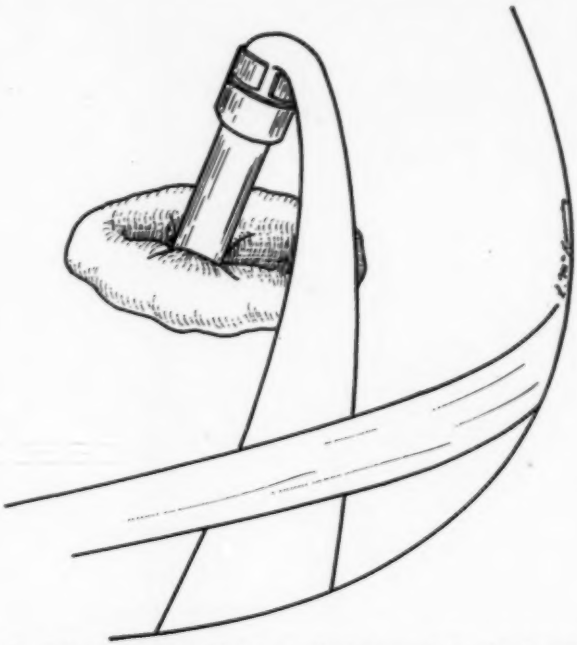

Fig. 2. Polyethylene articulated prosthesis in contact with invaginated perichondral graft. Note the ease with which prosthesis fits into the graft concavity.

a granuloma in the middle ear, *6.* delayed acute labyrinthitis following otitis media, with or without meningitis.

It became quite obvious that a very effective oval window seal is a necessity in stapedectomy surgery if we are to minimize these labyrinthine complications. Vein and fat grafts have been quite satisfactory in this regard, but gelfoam has

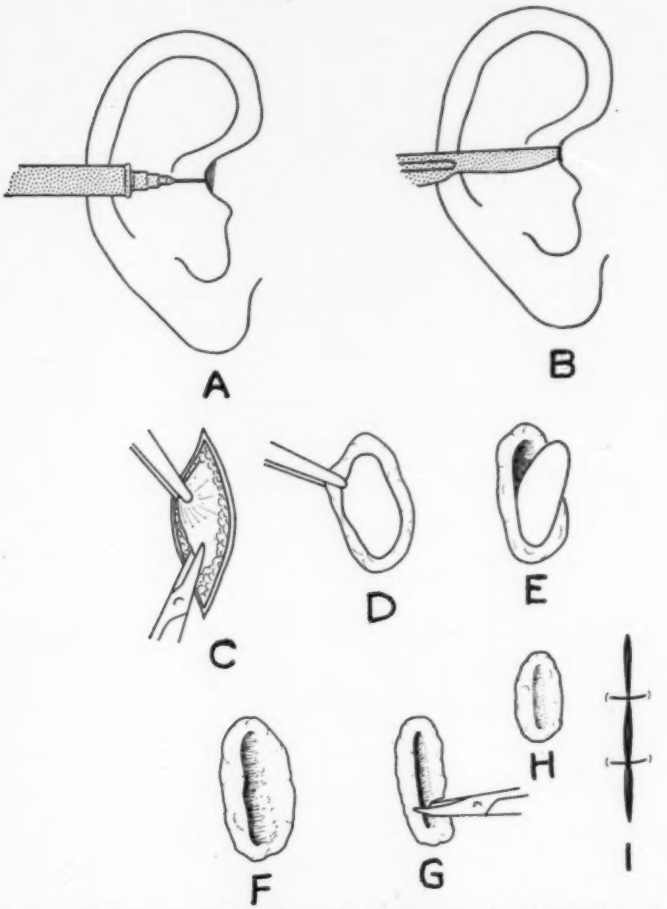


Fig. 3. Removal of perichondral graft from tragus. a.—Anesthetic infiltration. b.—Incision. c.—Dissection of tragal tip. d.—Inspection of concave aspect. e.—Enucleation of cartilage. f.—Perichondral graft before trimming. g.—Trimming of graft. h.—Completed perichondral pouch 4.5 mm. x 2 mm. i.—Closure of wound with 2 silk sutures.

been a frequent failure in this role. The vein graft, while quite effective as an oval window seal, structurally remains vein. The eventual fate of the vein graft in reference to thickness, compliance, elasticity and other acoustic characteristics is quite unpredictable, since the graft may become hypertrophied or atrophic, depending upon individual metabolic processes concerned with graft acceptance or rejection. The effect of venous adventitia on the vestibular perilymph

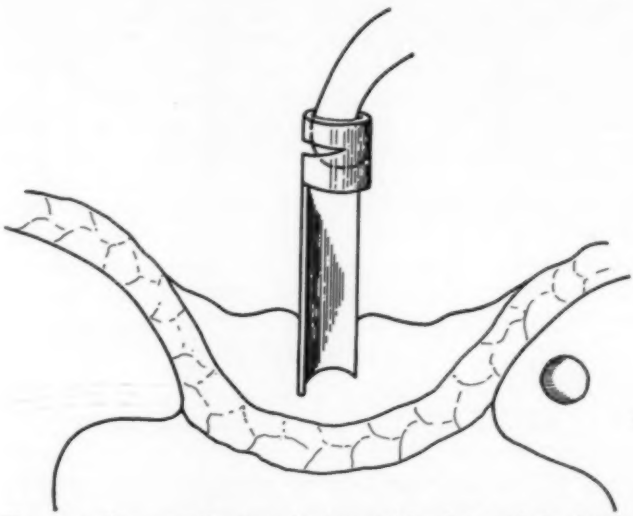

Fig. 4. A diagrammatic view showing perichondral graft in place over the oval window, with polyethylene articulated prosthesis in position.

space of the otosclerotic patient is not entirely understood. The fat graft may remain fat histologically but is more frequently replaced either all or in part by fibrous tissue. In both fat and connective tissue grafts the eventual acoustic characteristics are almost as unpredictable as they are with vein grafts. Gelfoam usually acts as the matrix for the formation of a thin mucoendosteal membrane, but it may be absorbed before completion of this membrane and may result in oval window fistula or may predispose to traumatic

intravestibular penetration of a slipped prosthesis. Fibrinous labyrinthitis and granulomatous labyrinthitis may occur with any of these grafts and a postoperative granuloma may involve both the middle ear and the labyrinth.

One cannot help but wonder whether the labyrinthine and tympanic fibroses observed may not represent allergic re-

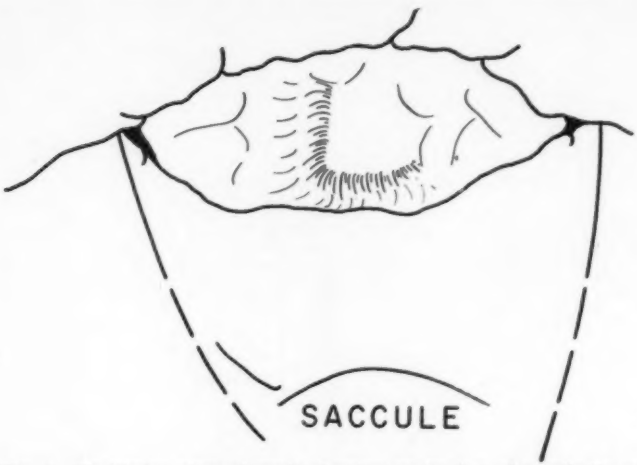


Fig. 5. Vestibular view of graft showing protrusion of prosthetic contact area. Note that prosthesis itself does not enter the vestibule.

sponses (in certain patients) to transplantation of tissues basically foreign to the recipient site.

Another area of concern in stapes surgery is that of the ultimate fate of any oval window graft in response to the dynamic growth of otosclerotic bone from the otic capsule into the footplate region. We know that otosclerosis is a rather diffuse otic capsular disease and may occur in a wide area around the fenestra ovalis. Indeed, it may occur in the round window, semi-circular canals, and even in the internal auditory meatus region; thus what is to prevent delayed infiltration of otosclerotic bone into the vein or into the fat graft and what will prevent such infiltration into the muco-endosteal seal which follows the use of gelfoam?

Since the normal footplate has perichondrium on its medial surface, and since the annular ligament itself is a specialized form of perichondrium, it occurred to me that we might consider the use of perichondrium from the tragal cartilage as an oval window graft. If perichondrium is non-irritating to the perilymph space, then perhaps a perichondral graft may be an ideal substance for a fenestra ovalis seal (see Fig. 1).

Does a transplant of healthy perichondrium from another location such as an auricular cartilage have special resistance to osteogenetic invasion from the surrounding otic capsule? On the contrary, might such perichondrium actually assume the osteogenetic characteristics of periosteum and actually lead to osteogenetic reankylosis? It is obvious that these specific questions cannot be answered by animal experimentation, since no disease realistically comparable to otosclerosis has yet been observed or induced in an experimental animal, and this type of question relates specifically to the peculiar osteogenetic characteristics of otosclerotic bone. (This, however, should not be construed as a criticism of experimental animal surgery in this area. The only criticism of animal surgery in this field is that we have not had enough of it. It should be encouraged widely.)

Since a thin, perichondrium, pouch-like graft can be obtained with ease from the tragal cartilage, a study of this substance for oval window closure in stapedectomy has been undertaken. In accordance with our present practice to employ total stapedectomy only in cases demonstrating significant otosclerotic involvement of the footplate (more than one-fourth of its square area), this graft is used only in such cases and is employed with the articulated polyethylene prosthesis.

When the tragus tip is amputated and the cartilage removed from it, a pouch or shallow sack of perichondrium remains with connective tissue on the convex surface and smooth perichondrium on the concave surface. After removal of the connective tissue layer this pouch forms an ideal seal for the oval window, since the convex aspect projects slightly into the perilymph space with the slightly curved sides snugly

hugging the curvatures of the oval window niche. It is then possible to insert the medial aspect of the articulated polyethylene prosthesis into the concave lateral aspect of this perichondral pouch, allowing firm anchorage to the graft.

The utilization of this perichondral graft is particularly applicable to the articulated polyethylene prosthesis previously described, since this prosthesis is firmly articulated laterally with the incus, and its medial extremity can contact the invaginated portion of the perichondral graft in a rather precise manner, exerting a gentle but firm pressure on the graft to keep it in position.

Early hearing results have been at least as good as those reported for fat grafts and vein grafts. The gains in hearing have been almost immediate and the vertiginous aspect of the labyrinthine reaction has been very mild.

This graft has considerable stiffness, but is still easily molded to the oval window niche. It is easily obtained from the tip of the tragus, which is already in the surgical field (see Figs. 2, 3, 4 and 5).

The tip of the tragus is infiltrated with 0.75 cc. xylocaine-adrenalin mixture as used in the endomeatal block. A vertical incision through skin and subcutaneous tissue exposes the perichondrium covered tip of the tragus. The latter is dissected free with small scissors and the tip grasped so that the terminal portion can be amputated (approximately 3 x 6 mm.). The wound is closed with two silk sutures.

The cartilage is removed from the concave aspect of the perichondral pouch and the entire pouch is carefully trimmed so that it consists only of perichondrium.

After the graft has been prepared it is placed in warm saline and the stapedectomy completed. Prior to removal of footplate fragments, periosteum is stripped from the fossa ovalis and bleeding controlled by pressure with adrenalin cotton. Care should be taken to remove carefully all traces of adrenalin before the perilymph space is opened.

Footplate fragments are usually removed by hemisection

of the footplate with chisel and elevation of anterior and posterior halves with lifting hooks. As soon as the perilymph space is opened the tailored graft is placed in position. Following placement of the graft the articulated prosthesis is attached to the incus and the notched medial end placed on the graft.

Since this graft seems to provide advantages theoretically not previously available with other tissue grafts, the preliminary report of its utilization appeared desirable at this time. Considerable study will be necessary to evaluate its eventual role in stapedectomy surgery.

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## AMERICAN LARYNGOLOGICAL ASSOCIATION AWARDS.

The DeRoaldes Award of the American Laryngological Association was presented to Dr. Frederick T. Hill, Waterville, Maine, in recognition of his many contributions to the specialty of otolaryngology and his services to the medical profession.

The Newcomb Award was presented posthumously to Dr. Chevalier Lawrence Jackson in recognition of his outstanding work in the field of bronchoesophagology and for his untiring devotion to the furtherance of cordial relations with the medical fraternity of South America.

# THE BRONCHOSCOPIST REPORTS TO THE THORACIC SURGEON.*

THOS. J. KINSELLA, M.D.,

Minneapolis, Minnesota.

The question as to who should perform bronchoscopic examinations has remained unsettled for many years, varying widely in different parts of the country. The Philadelphia group, under the leadership of Chevalier Jackson, trained many physicians in the field of otolaryngology and bronchoscopy and the techniques of this procedure. The Mayo Clinic group, under the guidance of Drs. Henry Plummer and Porter Vinson, placed this work in the medical diagnostic section. The Ann Arbor group, under Dr. John Alexander and his associates, placed it in the hands of the thoracic surgeons. There are a number of good reasons why each of the three groups might be delegated the responsibility for this procedure; however, no great controversy should develop over which one is chosen, for the answer is quite simple. The physician who is to perform bronchoscopic examinations and treatments should be the one whose technical skill, equipment and knowledge enable him to obtain and use or transmit to others the maximum possible amount of information which can be obtained by the procedure in each individual case.

Which of the three groups is best fitted to carry out the examination? There is much more to the procedure than merely passing the bronchoscope between the cords and down into the tracheo-bronchial area. From the standpoint of the anatomy of the structures involved, the otolaryngologist certainly has a better knowledge of the upper tract while the thoracic surgeon excels in that deeper down. The examination itself is a rather highly technical procedure; the instrumentation involved requires mechanical skills and dexterity more

*Read at the meeting of the Middle Section, American Laryngological, Rhinological and Otological Society, Inc., Minneapolis, Minn., Jan. 27, 1961.

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likely to be found in the otolaryngologist and the thoracic surgeon than in the internist. A wider knowledge of pulmonary and esophageal disease and physiology is more likely to be encountered in the internist or the thoracic surgeon than in the otolaryngologist. Certainly the man who has studied the patient and his chest clinically should have a better idea of what to look for and where to look for it than someone who is brought into the field cold to perform the mechanical procedure. The internist should lead the field in this category. On the other hand, who should be more interested in accurate localization of a lesion and its relation to other structures than the thoracic surgeon who may be called upon to treat it? Certainly, in order to obtain best results and the greatest amount of information, the procedure should be done by one who is carrying it out frequently and not by the occasional operator. All of this leaves us very much where we started. The choice should depend upon the individual's knowledge, training, ability, and experience rather than upon the name of his specialty.

The practice of thoracic medicine and surgery has so many facets that few men are qualified to cover all of them. Team work and close cooperation are essential. The internist, radiologist, bronchoscopist, pathologist, thoracic surgeon, anesthesiologist and possibly the radiotherapist must form a team whose integrated action must be as close as that of any ball team on the field if the patient's best interests are to be served. I will leave it to your judgment as to who is to be chosen to do which job.

What does the thoracic surgeon require of the bronchoscopist? The answer is, information, accurate, detailed, and complete, which will help him in diagnosis, localization and treatment. If he is not to obtain this information himself, then he must depend upon a report, oral, written, pictorial or all three, as indications warrant. Years ago we used to receive reports like: "left bronchus narrow" and nothing else. Such a report is worthless. The patient has been subjected to a procedure to no avail.

The bronchoscopist must not only see but also must record

and if possible interpret the significance of the findings. To do this he must be familiar not only with the anatomy of the bronchial tree, but also with pulmonary disease and its local manifestations. His report must be a record not only of what was found at the moment, but also one which can be referred to later if changes are to be discovered.

The Chinese proverb "One picture is worth ten thousand words" applies very well in this field, so a good labeled drawing should be a part of every permanent report. The importance of detail in recording even minor changes cannot be over emphasized, for small deviations which may have little apparent significance to one at the base of the scope may be highly significant to the internist or thoracic surgeon who has more knowledge of the patient's condition. For this reason, there must be close cooperation between all physicians involved. Consultation and briefing prior to the examination, with an explanation of what is suspected or what is to be ruled out, may be of great aid in obtaining or evaluating the findings. The bronchoscopist is not a mind reader and only the veterinarian is supposed to work without a history of some sort.

The bronchoscopist, surgeon, and internist must all speak and understand the same language if they are to convey their findings and thoughts to each other. This applies not only tc terminology but to anatomic structures and, particularly to anatomical points, especially the segmental divisions of the lung. Whether one uses the Jackson-Huber classification of the lung segments or the Boyden classification is immaterial, providing every one concerned uses and understands the same terminology. For convenience we prefer the Boyden classification, for it is simpler to say that such and such a lesion is in R-B 6 than it is to say that the same lesion lies in the superior division of the right lower lobe.

There should be a gentlemen's agreement as to what has been examined and which, if not specifically covered in the final report, may be assumed to be negative. Perhaps some simple code might be of value in expressing this. I well recall that years ago a certain roentgenologist in dictating chest

X-ray reports would say a simple code expression which meant plenty to those who were familiar with it and appeared in detail in the final typed report. For example, he might say: "Single X-ray film of the chest on William Jones on January 4, 1950 1- 2- 3-." Number *1* meant the heart and the aorta shadows are normal in size, shape and position. *2.* The diaphragm shadows have normal contour and are at normal levels. *3.* The bony structures of the thoracic cage show no evidence of fracture, destruction or distortion. He then proceeded with a description of the lung fields. A similar code might be worked out between individuals to indicate that a number of the important structures had been examined specifically and that they were negative. This would indicate to subsequent reviewers of the report that attention had been directed to these structures and that they were negative.

The bronchoscopist should at all times protect himself against possible infection, because neither he nor the referring physician may know the exact diagnosis. More than one friend of mine has acquired pulmonary tuberculosis from peering through a bronchoscope. Other infections of the face, the eye or the respiratory tract may likewise be acquired. It follows, therefore, that adequate masking with an impervious mask is essential, and that the hair, eyebrows, ears as well as the face should be protected against material coughed back through the scope at the examining physician. Large glasses should be worn to protect the eyes and, secondarily, the respiratory tract from contamination.

Just what information does a thoracic surgeon wish to obtain from the bronchoscopic examination? This point can be best stated by considering the various locations and conditions separately.

## LARYNX.

If the cords are normal in color, contour and mobility, say so. Redness, edema, infiltration, ulceration and granulation tissue should be reported. They have their significance and may explain the hoarseness as of local rather than deeper origin. Granulation tissue in the interarytenoid space may

result from previous ulceration, from tuberculosis, tumor, or from previous bronchoscopic or intratracheal tube trauma. Secretion or membrane on the larynx should be carefully removed and smears and cultures made. Tuberculosis can be diagnosed in this way, thus saving a few days time and possibly avoiding unnecessary contamination. Laryngo-tracheal bronchitis or diphtheria may also be proven in this way. Local tumors, benign or malignant, may be observed and biopsies taken to establish the diagnosis. Impaired motion of a vocal cord may result from local infiltration or from tumor interruption of the right laryngeal nerve, or the left recurrent laryngeal nerve in the mediastinum, or higher up in the neck from tumor of the thyroid. The opening of a pharyngeal-diverticulum (Zenker's Diverticulum) may at times be noted as the larynx is being exposed and should be reported, because this condition may be present before symptoms have developed to the point that they attract the patient's attention.

### TRACHEA.

The trachea is often overlooked in bronchoscopic examinations, the examiner being in such a hurry to see the carina that he passes his instrument through the trachea without inspecting it. Displacement of the trachea, deviations, rigidity, indentations, ectasia, stenosis, ulceration, tumor, abnormal pulsations all have significance and should be reported. Tumors and ulcerations of the trachea are rare, but they do occur and are easily overlooked. Extrinsic pressure upon the trachea, by tumor or lymph nodes, occurs not infrequently. Tuberculous lymph nodes, infected dermoid, bronchial or tracheal cysts may perforate the trachea. Carcinoma of the esophagus may perforate the posterior wall or fix a local area of the trachea or bronchus. Congenital or acquired tracheo-esophageal fistulas also occur. An abnormal take-off of a bronchus or a tracheal lobe cyst or a suis lobe may occasionally be found.

### SECRETIONS.

Not infrequently the amount of tracheobronchial secretion available for microscopic and cultural studies is small, con-

sequently, every bit that can be seen should be aspirated into a collecting tube and preserved for laboratory examination. The site of origin should be carefully noted if possible and distinction made between that which lies free in the trachea or major bronchi and that which wells up from a certain local area. The same applies to blood found in the tracheobronchial tree, for the most significant is that which wells up from a certain bronchial orifice. It is a well known fact that secretions and blood may be coughed from one lobe to another or from one side to the other. The exact site of active bleeding is especially important to the thoracic surgeon, in instances where resection for bronchiectasis or other hemorrhagic lesions is under consideration. The appearance of secretion or blood from an abnormal opening should be carefully documented and may be the clue which makes the diagnosis in a puzzling situation.

Appearances are sometimes deceiving, for a lung abscess may perforate across a fissure and drain through a segmental bronchus of a different lobe from that in which the abscess is located. The odor as well as the character of the secretion, whether mucopurulent or pus should be recorded. Pure pus usually indicates an abscess or an empyema pocket draining through a bronchial fistula. The bronchoscopist must not forget that at times the best specimen from the tracheobronchial tree may be collected from his own glasses. Bronchial washings are of value, but when taken indiscriminately they are not worth much. Bronchial washings to be studied for malignant cells must be taken from the lobe or segmental bronchus under suspicion and not merely from the right or left main bronchus.

Localization of the site of bleeding may be determined in several ways: by the patient's sensation early in a pulmonary hemorrhage; by a persistent wheeze or rattle early in the course of the bleeding; by X-ray demonstration of a lesion as a possible source, and bronchoscopically by a persistent welling up of blood from a certain bronchus after removal of the superficial accumulation. It must always be remembered that the significant bleeding may not come from the most

obvious site. This is well illustrated by a patient whose bleeding came from an unrecognized dental filling in his right lung and not from demonstrable bronchiectasis in the other side.

## CARINA.

Here two terms should be defined: Coryna means the bifurcation of the trachea. Carina means the keel of the boat and is the sharp spur which projects up from below where the right and left main bronchi take off. Inspection of this area may tell a great deal. Deviations of the carina from the midline may help localize a lesion which is pushing or pulling the trachea to one side or the other. Change in the angle of take-off of a bronchus may indicate reduction or over expansion of a lobe. Downward displacement of the left main bronchus gives evidence of atelectasis or reduction in volume of the left lower lobe. Increase in the angle of take-off suggests elevation of the hilar structures on that side with a reduction in volume of the upper lobe or a portion of it. Broadening of the carinal angle suggests tumor beneath the carina or enlarged lymph nodes in this region, a not infrequent finding in bronchogenic carcinoma with mediastinal lymph node metastases. Narrowing of the bronchial lumen without intrinsic disease or rigidity of a bronchial wall may occur from a similar lesion or result from submucosal infiltration of the bronchial wall by tumor. Weakening of the bronchial wall or unusual flaccidity suggests broncho-malacia with destruction of cartilage from bronchial disease. Abnormal pulsation of trachea bronchial wall or carina is suggestive of a vascular lesion or enlarged lymph nodes interposed between a pulsating vessel and the bronchial wall and should be reported. The absence of the normal opening and closing of bronchi with respiration should also be documented as it may be significant. Redness, swelling, edema, infiltration, ulceration or granulation tissue should be noted. Localized areas of granulation tissue may follow previous ulceration as in tuberculosis, or may result from perforation of an adjacent suppurating lymph node or perforation of a calcified lymph node through the bronchial or tracheal wall.

Foreign bodies must always be sought even if there is no history to suggest their presence because they may be of intrinsic as well as extrinsic origin. Granulation tissue may so conceal a foreign body that even repeated bronchoscopy by experts may fail to discover the offender. Granulomatous areas may result from perforation of a Hodgkin's lymph node or be present on the surface of a bronchial carcinoma to confuse the picture. Lymph node enlargement in the hilar and sub-hilar region may produce bronchial obstruction as seen in the middle lobe syndrome, in some segmental atelectasis and in bronchiectasis secondary to old primary tuberculosis or histoplasmosis.

Bronchogenic carcinoma has a considerable tendency to give submucosal extension proximal to the tumor site; hence, if any rigidity is noted proximal to an offending tumor, the mucosa should be biopsied even though appearing normal on the surface. Such submucosal infiltration, particularly in the region of the coryna, may render an otherwise resectable tumor non-resectable. Biopsy of an apparently normal mucosa in the region of the carina, in patients suspected of having Boeck's sarcoid, should be done routinely, and nearly half of them will show evidence of sarcoid infiltration. The danger of perforation of the carina is not great unless the operator becomes too ambitious and tries to take too large or too deep a bite.

To be of greatest value a biopsy must be obtained from a significant or suspicious area and deep enough really to obtain characteristic tissue. Granulation tissue on the surface of an ulcerating carcinoma may conceal the true nature of the underlying lesion. Direct sponge imprints for cell study may at times give as much information as biopsy.

Aspirated secretions for Papanicolaou cell studies are extremely valuable especially in tumors beyond the reach of biopsy forceps but should be taken from the segment involved to be of greatest value. The same applies even more strongly to bronchial washings for cell studies.

### FOREIGN BODY.

The history may or may not be a help in recognizing or discovering a foreign body, which may be of either extrinsic or intrinsic origin. Those of intrinsic origin from an extruded calcarious deposit from a lymph node or broncholith are, of course, without suggestive symptoms. Even those of extrinsic origin may give no history, for the patient unconscious or stupefied by drink or drugs may have no recollection of aspirating the foreign body. The metallic and shadow-casting kind are easy to recognize, but the nonopaque type presents greater difficulties. A foreign body must always be suspected in all atelectatic and suppurative situations and a careful search made in all localized lesions, especially in putrid abscess, bronchiectatic segments and in areas of extensive granulation tissue. Even when suspected, a foreign body may be missed at times by an experienced bronchoscopist.

### BRONCHOGRAMS.

Although there are those who discount the value of bronchograms in the diagnosis of pulmonary disease, the fact remains that their value is in almost direct ratio to the care and diligence employed in making them. A poor bronchogram is worse than useless, while a good one is invaluable. The making of a good bronchogram entails close cooperation between bronchoscopist, radiologist and anesthesiologist for best results. Certainly in bronchiectasis, no other medium can give the precise information needed for its proper evaluation, but unless each and every segment is visualized the study is incomplete. Both negative as well as important positive information can be obtained by it. Likewise, in tuberculosis, particularly in patients under consideration for surgical procedures, a knowledge of broncho-stenosis, atelectasis and secondary bronchiectatic change is essential and may be obtained only by this means. Cystic disease, bullous emphysema, certain tumors, localized fluid or empyema pockets, sequestration and a number of other conditions present situations in which bronchograms can aid very materially. Bronchogenic carcinoma, especially tumor beyond bronchoscopic view or biopsy, may also be localized by properly made bronchograms.

The bronchoscopist is an indispensable member of the thoracic surgical team. His value is in direct proportion to the accuracy of the information which he contributes to the problem at hand. His examination and his reports of it may well determine his true position on the thoracic team.

1251 Medical Arts. Building.

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## CORRECTION.

We have been requested to make the following correction in the paper Application of Fluothane Anesthesia to Otolaryngological Surgery by Drs. Rufus C. Morrow, Elmer M. Reed and John Abajian in the May issue of THE LARYNGOSCOPE. The third paragraph on page 546 should read:

The preanesthetic routine which we use is a mixture of alphaprodine (Nisentil), 40 mg. in the adult or 15 mg. per 50 pounds in a child; scopolamine, 0.4 mg. in the adult, 0.15 mg. per 50 pounds in the child; and levallorphan (Lorfan) 0.8 mg. in the adult and 0.4 mg. per 50 pounds in the child. These are given intramuscularly 45 minutes preoperatively.

# DIRECTORY OF OTOLARYNGOLOGIC SOCIETIES.

**(Secretaries of the various societies are requested to keep this information up to date).**

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### AMERICAN ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY.

President: Dr. John H. Dunnington, New York, N. Y.
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Meeting: Palmer House, Chicago, Ill., October 8-13, 1961.

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Alternate Delegate: Dr. Paul H. Holinger, Chicago, Ill.
Representative to Scientific Exhibit: Dr. Walter H. Maloney, Cleveland, O.
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Annual Clinical Session: Chicago, Ill., October, 1961 (definite time and place to be announced later).
Annual Meeting: Chicago, Ill., October, 1961 (definite time and place to be announced later).

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